See the possibilities

User's Manual

BM-500CL
BB-500CL

Digital Monochrome/Color 5 megapixel Camera with Camera Link interface

Document Version: 1.6
BMB-500CL_Ver.1.6_June2013

Notice

The material contained in this manual consists of information that is proprietary to JAI Ltd., Japan and may only be used by the purchasers of the product. JAI Ltd., Japan makes no warranty for the use of its product and assumes no responsibility for any errors which may appear or for damages resulting from the use of the information contained herein. JAI Ltd., Japan reserves the right to make changes without notice.

Company and product names mentioned in this manual are trademarks or registered trademarks of their respective owners.

Warranty

For information about the warranty, please contact your factory representative.

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that BM-500CL and BB-500CL comply with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning

Changes or modifications to this unit not expressly approved by the party responsible for FCC compliance could void the user's authority to operate the equipment.

Supplement

The following statement is related to the regulation on " Measures for the Administration of the control of Pollution by Electronic Information Products " , known as " China RoHS ". The table shows contained Hazardous Substances in this camera.

mark shows that the environment-friendly use period of contained Hazardous Substances is 15 years.

重要注意事项

有毒，有害物质或元素名称及含量表

根据中华人民共和国信息产业部『电子信息产品污染控制管理办法』，本产品《 有毒，有害物质或元素名称及含量表 》如下.

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
螺丝固定座	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006规定的限量要求。
（企业可在此处、根据实际情况对上表中打 " × " 的技术原因进行进一步说明。）

环保使用期限

电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。

数字「15」为期限15年。

Supplement

The following statement is related to the regulation on " Measures for the Administration of the control of Pollution by Electronic Information Products " , known as " China RoHS ". The table shows contained Hazardous Substances in this camera.

mark shows that the environment-friendly use period of contained Hazardous Substances is 15 years.

重要注意事项

有毒，有害物质或元素名称及含量表

根据中华人民共和国信息产业部『电子信息产品污染控制管理办法』，本产品《 有毒，有害物质或元素名称及含量表 》如下.

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
螺丝固定座	×	○	○	○	○	○
光学滤色镜	×	○	×	○	○	○
.....	.....	.....	.....	.....	.....	.....

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006规定的限量要求。
（企业可在此处、根据实际情况对上表中打 " × " 的技术原因进行进一步说明。）

环保使用期限

电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。

数字「15」为期限15年。

- Contents -

1. General

BM-500CL is a monochrome progressive scan CCD camera and the BB-500CL is the equivalent Bayer mosaic progressive scan CCD camera. Both have 5 million pixels resolution.
These cameras are suitable for a wide range of applications within factory automation, an also for applications outside the factory floor, such as ITS (Intelligent Traffic Solutions), high-end surveillance and medical.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for BM-500CL/BB-500CL can be downloaded from: www.jai.com
For camera revision history, please contact your local JAI distributor.

2. Camera nomenclature

The standard camera composition consists of the camera main body and C-mount protection cap.

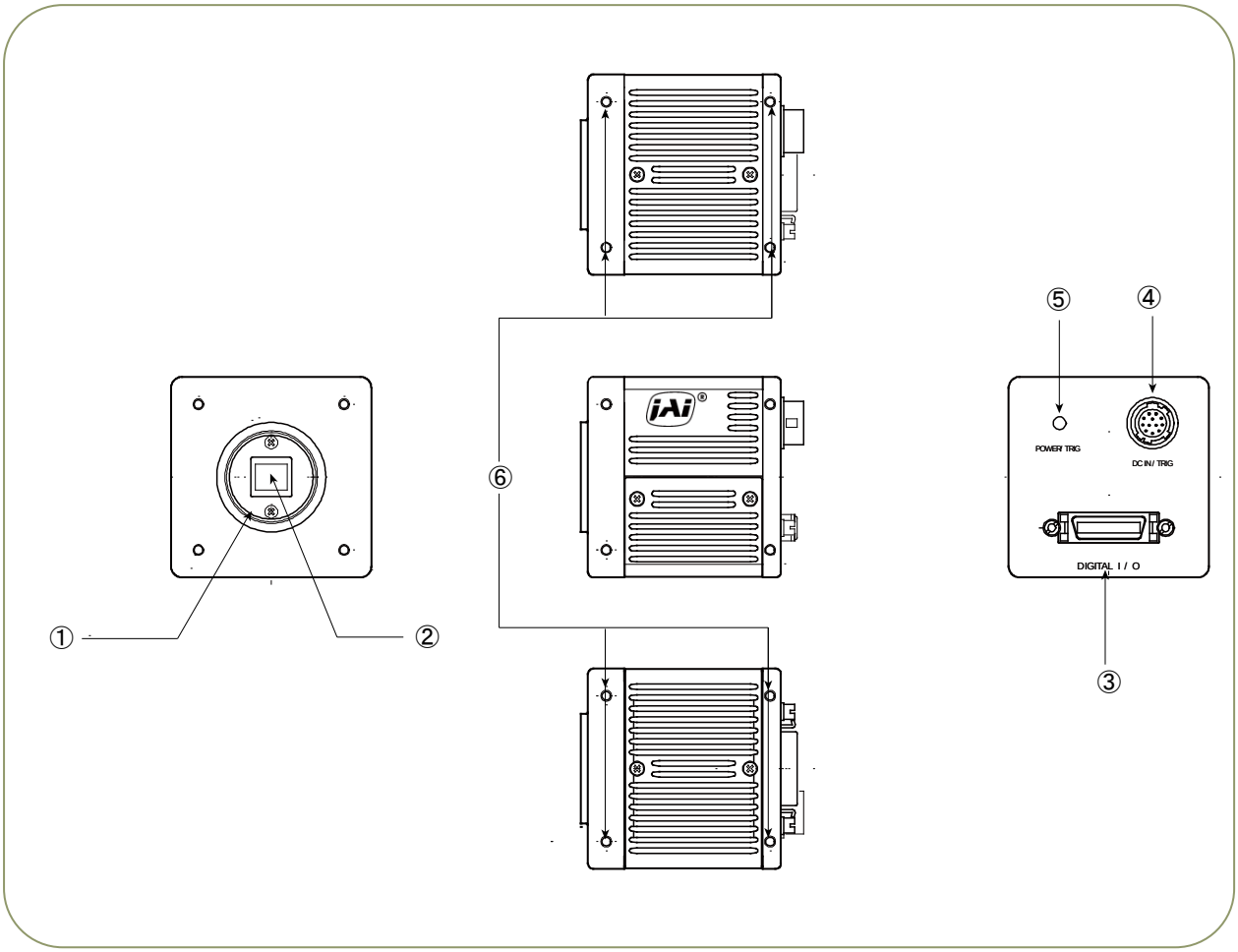
The camera is available in the following versions:
BM-500CL
Where **B** stands for "Basic" family, **M** stands for "Monochrome", **500** represents the resolution "5 million pixel" and **CL** stands for "Camera Link" interface

BB-500CL
Where **B** stands for "Basic" family, **B** stands for "Bayer mosaic color", **500** represents the resolution "5 million pixel" and **CL** stands for "Camera Link" interface

3. Main Features

- C3 Basic series 2/3 ” progressive scan camera
- Monochrome and Bayer mosaic color versions
- 2456 (h) x 2058 (v) active pixels
- 3.45 µm square pixels
- 15.05 frames/second with full resolution in continuous operation
- 15 frames/second with external trigger and full resolution
- Up to 43.6 frames/second with partial scan
- 22.9 frames/second with vertical binning (BM-500CL only)
- Draft mode reads out 4 lines out of every 16 lines with 37.54 fps
- Shutter speed from 64.13 µs to 2 sec. using Pulse Width Trigger
- Programmable exposure from 64.13 µs to 66.44 ms
- Pre-select and Pulse width trigger modes
- Built in LUT (Look Up Table)
- 2 types of Auto White Balance , One push and Preset
- LVAL-synchronous/-asynchronous operation (auto-detect)
- Auto iris lens video output allows a wider range of light
- 12- or 10- or 8-bit output
- Setup by Windows NT/2000/XP via serial communication

4. Locations and Functions



①	Lens mount	C-mount (Note *1)
②	CCD sensor	2/3 inch CCD sensor
③	26-pin connector	Camera Link Interface (Note *2)
④	12-pin connector	DC+12V and trigger input
⑤	LED	Indication for power and trigger input
⑥	Mounting holes	M3 depth 5mm for tripod mount plate (Note *3)

*1) Note: Rear protrusion on C-mount lens must be less than 10.0mm.

*2) Note: When a Camera Link cable is connected to the camera, please do not excessively tighten screws by using a driver. The Camera Link receptacle on the camera might be damaged. For security, the strength to tighten screws is less than 0.291 Newton meter (Nm). Tightening by hand is sufficient in order to achieve this.

*3) Note: The part number for the tripod adapter plate (with 1/4"-20 thread) is MP-41 (option).

Fig. 1. Locations

5. Pin Assignment

5.1. 12-pin Multi-connector (DC-IN/Trigger)

Type: HR10A-10R-12PB-01 (Hirose) male.
Use the part number HR10A-10P-12S for the cable side

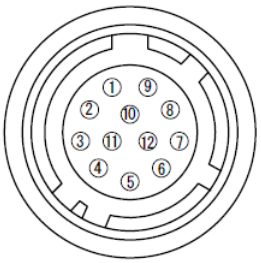


Fig. 2 Hirose 12-pin connector

Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Iris video	Only for Continuous mode. TR=0
5	GND	
6	NC	
7	NC	
8	GND	
9	XEEN out	*1)
10	Trigger in	TI=1 (or Camera Link TI=0). *2) *3) 75 ohm termination
11	DC+12V	
12	GND	

*1) XEEN output can be configured with complementary emitter follower circuit or open collector by internal switch setting. The default is the complementary emitter follower circuit. See chapter 5.3.3 for details.
*2) Factory default is trigger via Camera Link
*3) 75 ohm termination can be enabled by SW 800. See Chapter 7.1

5.2. Digital Output Connector for Camera Link

Type: 26-pin MDR connector (3M 10226-1A10PL)

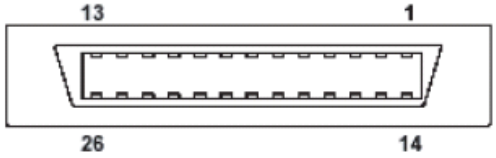


Fig.3 26-Pin Camera Link Connector

Pin No	In/Out	Name	Note
1,14		Shield	GND
2(-),15(+)	O	TxOUT0	Data out
3(-),16(+)	O	TxOUT1	
4(-),17(+)	O	TxOUT2	
5(-),18(+)	O	TxClk	Clock for CL
6(-),19(+)	O	TxOUT3	Data out
7(+),20(-)	I	SerTC (RxD)	LVDS Serial Control
8(-),21(+)	O	SerTFG (TxD)	
9(-),22(+)	I	CC1 (Trigger)	Trigger IN
10(+),23(-)		N.C	
11,24		N.C	
12,25		N.C	
13,26		Shield	GND

5.3. Input and output circuits

In the following schematic diagrams the input and output circuits for video and timing signals are shown.

5.3.1. Iris video output

This signal can be used for lens iris control in Continuous mode. The signal for iris video output is taken from the video signal after the gain control. The signal is 0.7 Vpp (without sync) from 75 Ω without termination.

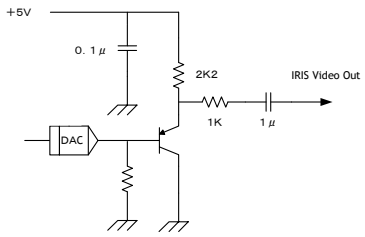


Fig. 4. Iris video

5.3.2. Trigger input

An external trigger input can be applied to pin 10 of 12-pin Hirose connector (when the command TI=1 has been set). The input is AC coupled. To allow long pulses the input circuit is designed as a flip-flop circuit. The leading and trailing edges of the trigger pulse activate the circuit. The trigger polarity can be changed by TP=1.
Trigger input level 4 V ±2 V.
Trigger can also be applied through the Camera Link connector, when the command TI=0 has been sent.

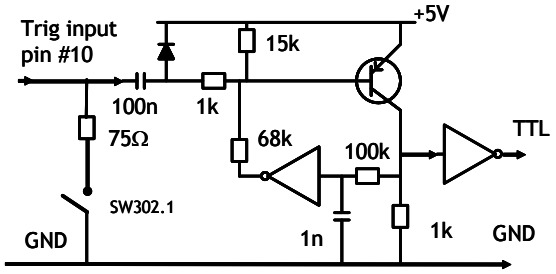


Fig. 5. Trigger input.

5.3.3. XEEN output

XEEN is on pin 9 on 12-pin Hirose connector.
The output uses either a complementary emitter follower circuit or open-collector. The output of the complementary emitter follower circuit is ≥ 3 V. (No termination)
When the open corrector output is used, the maximum current is 120mA. However, if the current is more than 50mA, use thicker cable for connecting pins #8 and #9. If the narrower cable is used, it might happen the malfunction due to the resistance of the cable.
The output can be selected by switch SW800 located inside the camera (rear board).

EEN is also found in Camera Link.

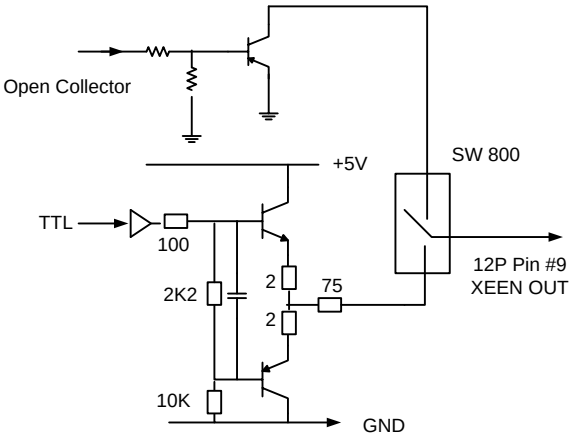


Fig. 6. XEEN output

5.3.4. Camera Link interface

The digital video is available via Camera Link, with 8-,10- or 12-bit pixel depth, using the CL Base configuration. The digital output signals follow the Camera Link standard using Channel Link chip sets.
The data bits from the digital video, FVAL, LVAL, DVAL and EEN are multiplexed into the twisted pairs, which are a part of the Camera Link. Trigger signals and the serial camera control are feed directly through its own pairs.

The 26-pin MDR Camera Link connector pin assignment follows the Camera Link base configuration.

For a detailed description of the Camera Link standard, please refer to the Camera Link standard specifications found at the AIA web site, www.machinevisiononline.org.

6. Functions and Operations

6.1. Basic functions

The BM-500CL / BB-500CL cameras is a progressive scan camera with 5 Mega pixels monochrome or Bayer mosaic color CCDs. The interface to the host PC is via digital Camera Link. Both models output video as 8-, 10- or 12-bits. The color version BB-500CL outputs raw Bayer video, requiring host based color interpolation. The camera also features several pre-processing functions (see chapter 6.2)
An analogue iris-video signal can be used for controlling the iris of an auto-iris lens when operating in continuous mode.
The camera has both variable partial scan (user programmable) or fixed 2/3, 1/2, 1/4 and 1/8 image height. It also features vertical binning (BM-500CL only) and decimation readout (draft) mode for faster frame rates.
There are 2 trigger modes in addition to continuous operation. The Pre-Select and Pulse Width trigger modes are available with a unique automatic LVAL sync or a-sync selection function.

Below the functions are described in detail below.

6.1.1. Digital Video Output (Bit Allocation)

The 10-bit digital output is set 890 LSB as 100% video level when CCD output is 200mV.
The white clip level is set at 1023 LSB when CCD output is 230mV.

CCD out	Analogue level	Digital Out		
		8 bits	10 bits	12 bits
Black	Setup 3.6%, 25mV	8 LSB	32 LSB	128 LSB
200mV	700mV	222 LSB	890 LSB	3560 LSB
230mV ↑	800mV	255 LSB	1023 LSB	4095 LSB

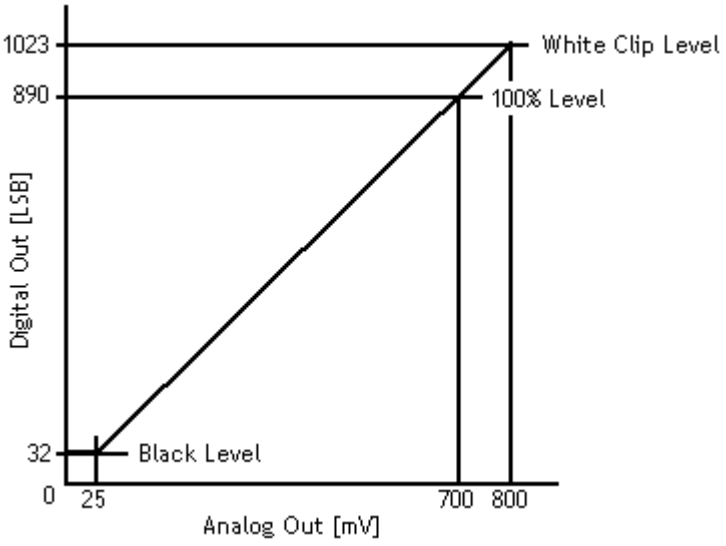


Fig.7. Digital Output Bit Allocation (In case of 10 bits)

6.1.2. Electronic Shutter

The BM/BB-500CL allows selecting shutter speed in two ways; preset shutter (10 fixed steps) and programmable exposure (in 2072 line period, LVAL increments).

Preset Shutter (SH)

The following shutter speeds can be selected by command SH=0 through SH=10.
OFF (1/15),1/30, 1/60, 1/100, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000 seconds

Programmable Exposure (PE)
The exposure time can be programmed in 32.067µs (LVAL period) increments. The range is from 2 LVAL to 2072 LVAL.

Minimum exposure time 2L	Maximum exposure time 2072 L
32.067µs x 2(L) = 64.13 µs	32.067µs x 2072 (L) ≈ 66.44 ms

In binning mode:

Minimum Exposure time 2L	Maximum exposure time 1029 L
42.067 µs x 2(L) = 84.13 µs	42.067 µs x 1029 (L) ≈ 43.71 ms

In draft mode

Minimum exposure time 2L	Maximum exposure time 261 L
102.066 µs x 2(L) = 204.132 µs	102.066 µs x 261 (L) ≈ 26.64 ms

Auto Shutter (ASC)
The setting command is ASC. This command activates the Auto shutter function. This function controls the shutter speed according to light changes and keeps the specified video level.

Auto shutter controls range : 1/250s (PE 125) to 1/15s (PE 2072))
Control speed: Set by ASC speed, 1 to 16 steps
Target level: Set by ALC reference
This is common for AGC

6.1.3. Continuous operation or triggered operation

The camera can operate in continuous operation applications not requiring asynchronous external trigger. This mode permits the use of a lens with video controlled iris. The camera will operate at its maximum frame rate, 15.05 frames/seconds in this mode.

For applications that require an external trigger, the camera can accept an external trigger input on pin 10 of the 12-pin Hirose connector or via the Camera Link interface. The command "TI" is used to switch between inputs.
The camera can operate up to 15 frames/second in triggered operation.

6.1.4. Iris video output.

The iris video output on pin 4 of the 12-pin Hirose connector output 700 mV when the video out in Camera Link is at the 100% level . The iris video signal is taken after the gain circuit. It is without sync.
The iris video signal can be used for auto iris lens drive in continuous mode.

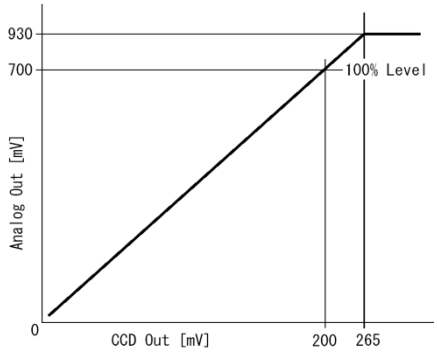
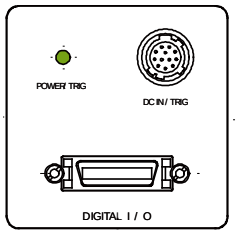


Fig. 8. Iris video output.

6.1.5. Rear panel indicator.



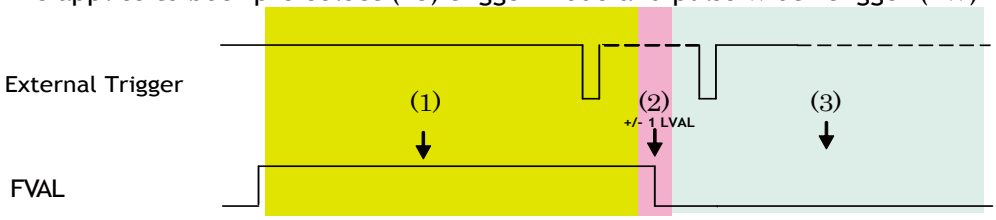
The rear panel mounted LED provides the following information:

- Amber: Power connected - initiating
- Steady green: Camera is operating in Continuous mode
- Flashing green: The camera is receiving external trigger

6.1.6. Auto-detect LVAL-sync / a-sync accumulation

This function replaces the manual setting found in older JAI cameras. Whether accumulation is synchronous or a-synchronous in relationship to LVAL depends on the timing of the trigger input. When trigger is received while FVAL is high (during readout), the camera works in LVAL-synchronous mode, preventing reset feed trough in the video signal. There is a maximum jitter of one LVAL period from issuing a trigger and accumulation start.
When trigger is received during FVAL low, the cameras works in LVAL-asynchronous mode (no delay) mode.

This applies to both pre-select (PS) trigger mode and pulse width trigger (PW) mode.



(1) In this period camera executes trigger at next LVAL (prevents feed-through noise)

(2) Avoid trigger at FVAL transition (+/- LVAL period), as the function may randomly switch between " next LVAL " and " immediate ".

(3) In this period, camera executes trigger immediately (no delay).

Fig.9 Auto-detect LVAL sync/a-sync accumulation

6.1.7. Starting pixel - Bayer color mosaic

The BB-500CL is a color camera based on a CCD sensor with a Bayer color mosaic.
The color image reconstruction is done in the host PC.
The color sequence in the video signal is the same for any scanning modes except the programmable partial.
The right hand drawing shows the color sequence at the image start.
The starting line number is shown from LVAL.
The first active pixel starts from LVAL, when DVAL rises.

Even lines starts with GBG.
Odd lines starts with RGR

See also chapter 6.1.8 Partial Scan

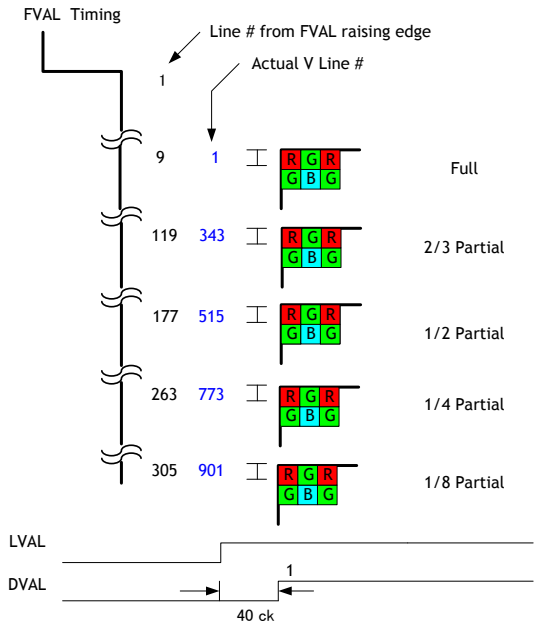
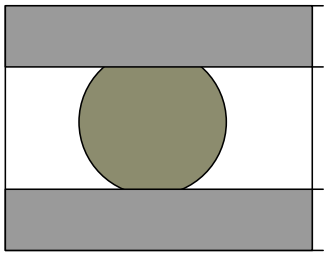


Fig. 10. Bayer color mosaic

6.1.8. Partial Scanning

The partial scanning function uses the middle of the image vertically to achieve faster frame rate. This is effective for capturing and inspecting the image which does not require the height. BM-500CL/BB-500CL has 4 types of partial scan modes such as 2/3, 1/2, 1/4 an 1/8.



Mode	Start line	End line	Frame Rate
2/3	343	1716	19.97 fps
1/2	515	1544	23.93 fps
1/4	773	1286	34.04 fps
1/8	901	1158	43.07 fps

Variable Partial Scan

Additionally, BM-500CL/BB-500CL has variable partial scan. The start line and end line of the image can be set by the command STL and ETL.
The command PRGP = 1 is used to activate this function.

Line setting	Command	Parameter
Start line	STL =	2 to 2058
End line	ETL =	2 to 2058

The effective read out lines can be calculated from the following formula.

The End line – the Start line + 1

Frame rate calculation

Frame rate (fps) = 1/ (Total LVAL number of 1 frame x 32 µs)

Total LVAL number of 1 frame
= FVAL LOW period + Upper Fast dump period + Normal read out period + Lower Fast dump period

FVAL LOW = 4 (lines)

Upper Fast Dump period = $\frac{Start\ Line+5}{3}$ + 2 (lines)
Note) The first decimal place is rounded up.

Normal read out = The End line – the Start line + 1 (lines)

Lower Fast Dump period = $\frac{2060-the\ End\ line}{6}$ + 7 (lines)
Note) The first decimal place is rounded up.

6.1.9. Vertical Binning

This function is only available on the BM-500CL camera.
Binning mode (Command VB) is a function where the signal charge from 2 adjacent (vertical) pixels are added together and read out as one pixel. Binning results in half vertical resolution and higher frame rate. By adding 2 pixels together, the sensitivity is doubled. The charge accumulated in 2 adjacent lines is added together in the horizontal CCD register. This is done by providing two pulses to the vertical CCD register for each line readout. Vertical binning can not be used together with the Partial scan.

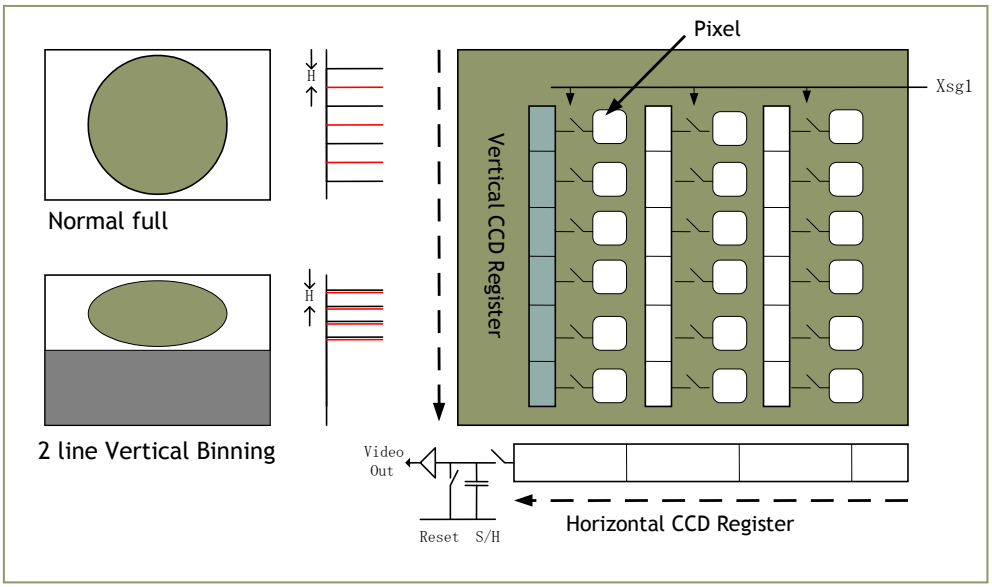


Fig. 11. Vertical Binning

6.1.10. Decimation readout (Draft) mode

BM-500CL/BB-500CL has a decimation readout (draft) mode. 4 lines of every 16 lines are read out. In the BB-500CL a similar scheme is applied, but 2 GB lines and 2 RG lines combined, in order to facilitate Bayer to RGB conversion (see fig. 12). When using this mode the field of view is maintained but the height of the image is reduced to 1/4. The frame rate is 37.54 frames per a second.

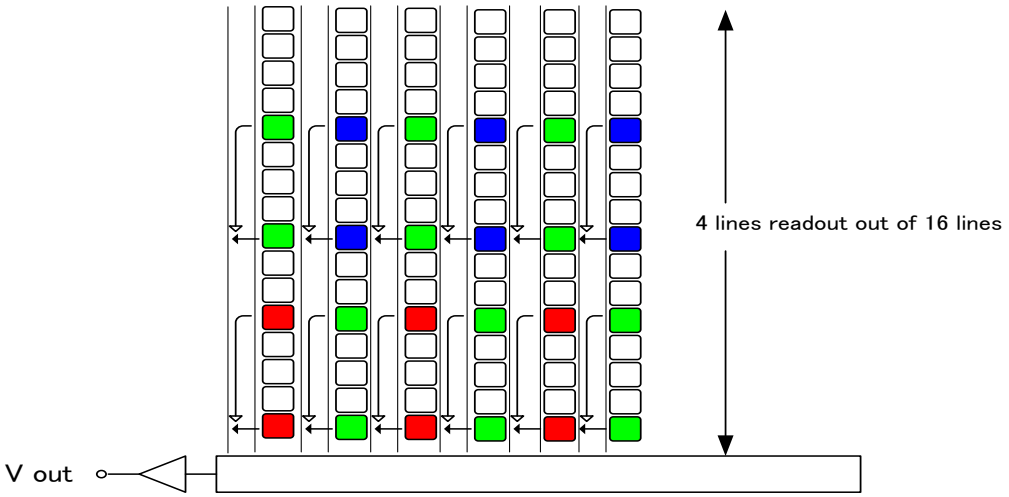


Fig.12. Draft mode (as applied to BB-500CL)

6.2. Pre-process functions

BM-500CL/BB-500CL has several pre-processing functions. The output from the camera is selectable to 8-,10- or 12-bits but video is digitized to 14-bit internally.
The pre-processing functions make use of the 14-bit video. Featured functions are: white balance (BB-500CL only), R/L channel balance, blemish compensation, gain control and LUT (Look Up Table) for Gamma and Knee correction.

6.2.1. Bayer White Balance

Normally, the raw Bayer color signals are sent to the host as they are. In the host, the signals are interpolated to generate an RGB image and perform white balance.
In order to offload the host, the BB-500CL can adjust Gr, R , Gb and B levels individually to get the white balance for the Bayer output signal. The gain is fixed to 1.0 for BM-500CL.

White Balance Type	Setting
Preset (3200K , 4600K , 5600 K)	AWBM=1 (3200), = 2 (4600), = 3 (5600)
One –Push White Balance	AWBM=0 (One-push), AWB = 1 for activate (2600K to 6500K)
Manual	Set by pixel gain (R1/R2, GR1/GR2, B1/B2, GB1/GB2)
White Balance Area s	Select 6 divided area for both L and R channels

Note : Bayer white balance should be adjusted in continuous mode.

6.2.2. Gain Control

The gain can be set from -3dB to +24dB using Low or High as the reference. The adjustment step is 0.0358dB.

Low: 0dB
Range : BM-500CL -3dB to +24dB
BB-500CL -3dB to +24dB

High: +6dB for BM-500CL
Range : +3dB to +30dB

+9dB for BB-500CL
Range: +3dB to +33dB

Adjustment range:
Manual: -3dB to +24dB
Auto(AGC): Range:-3dB to +24dB
AGC Max. or AGC Min, can be set.
Control speed: Set by AGC speed
1 to 16 steps
Target level: Set by ALC reference
This is common for ASC.

6.2.3. Tap Balance

BM-500CL/BB-500CL has dual-tap readout architecture, with a Left (L) and Right (R) channel. In order to achieve the same gain and black level for both channels, the BM-500CL/BB-500CL has built -in Tap Balance function. The function is activated by Manual or a “one-push” software command.

TBA : Adjust both the black and video levels whenthe command is activated.
ABA : Adjust the black level in the right and left to be equal when the command is activated.
AWA : Adjust the video level in the right and left to be equal when the command is activated.

Channel Balance Type	Setting
Tap Balance Auto	TBA=1 for activation
One-Push Gain (Auto White Level Adjust, AWA)	AWA=1 for activation
One-Push Auto Black Level Adjust (ABA)	ABA=1 for activation

Note: 1. Channel Balance adjustment should be done in the continuous mode.
2. One push channel balance should be done the following order, ABA and then AWA.

6.2.4. Auto iris control (AIC)

This function controls the lens iris to get the proper video level under various lighting circumstances. The applicable lens should have the video level controlled iris.

ON: Operate as ALC function together with ASC and AGC functions
OFF: Only AIC is working

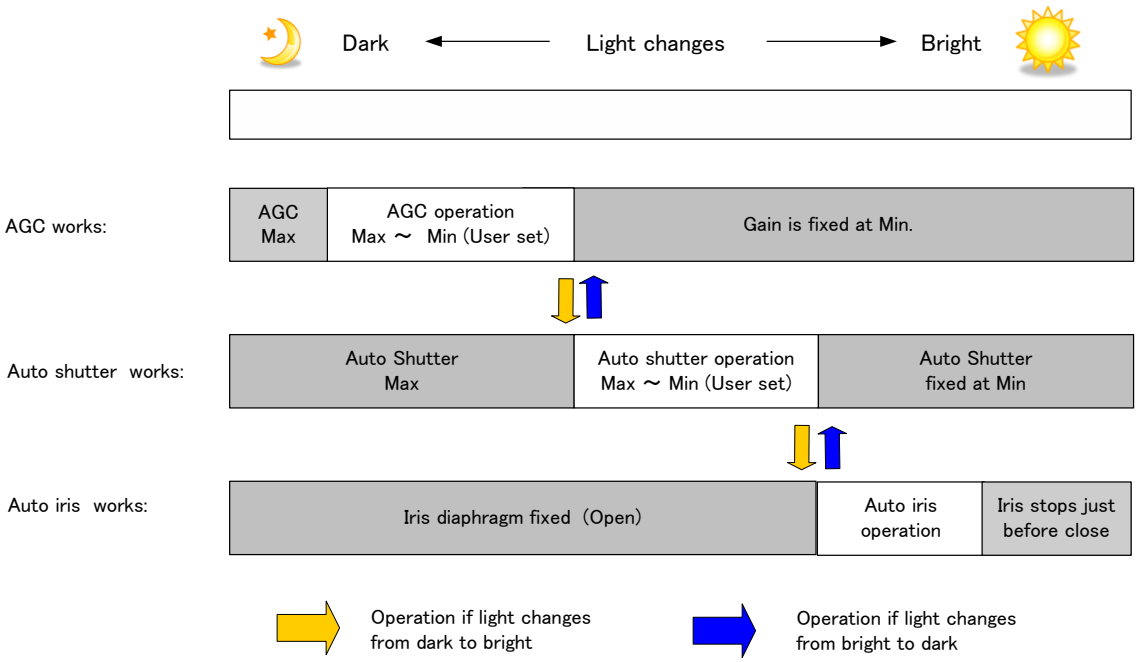
6.2.5. ALC Automatic output level controls

In the BM-500CL and BB-500CL, auto gain, auto shutter and auto iris functions can be combined to provide a wide ranging automatic exposure control from dark to bright or vice versa.

The functions are applied in the sequence shown below and if one function is disabled, the linkage between the other two is maintained.

In order to make the ALC function effective, set the Auto Iris Lens Control Signal Output to “ON”. The auto iris function (AIC) works together with AGC and Exposure Auto (ASC).

If the lighting condition is changed from bright to dark AIC — ASC — AGC
If the lighting condition is changed from dark to bright AGC — ASC — AIC

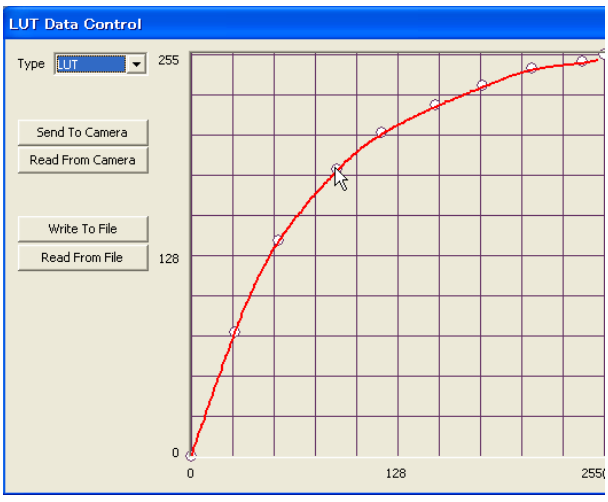


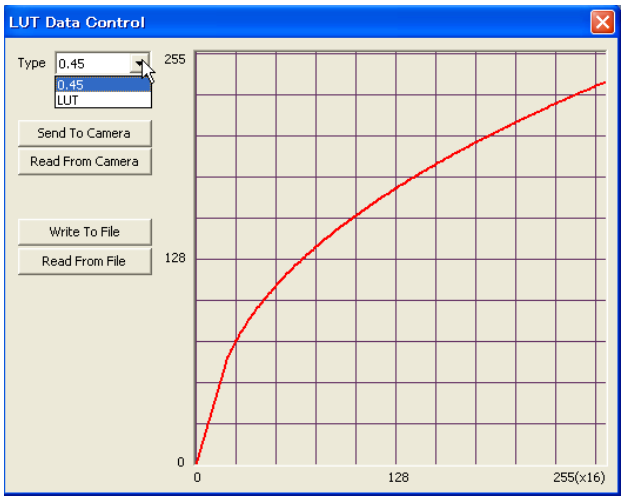
ALC reference (Command AGCF)
This sets the reference level of the video output using AGC. The parameter is from 0 to 1023, where [0] represents 0 level of the average video output and 1023 represents 100% video level.

6.2.6. Programmable Look-Up Table (LUT)

BM-500CL/BB-500CL has a programmable look-up table (LUT) that lets the user adjust the transfer function of the video output.
Selectable settings include multiple-point LUT and Gamma 0.45.

The look up table has 256 setting points by which the full range of input signal is divided. On each of the point, the gain can be set to get a required transfer function. In case of BB-500CL, Gr, R, Gb and B signals have the same characteristics. Gamma 0.45 or programmable LUT can be selected by software control. If the LUT is not configured, Gamma is set at 1.0 (OFF).





6.3. Sensor Layout and timing

6.3.1. CCD Sensor Layout

The CCD sensor layout with respect to pixels and lines used in the timing and video full frame read out is shown below. For Bayer color sequence, refer to chapter 6.1.7.

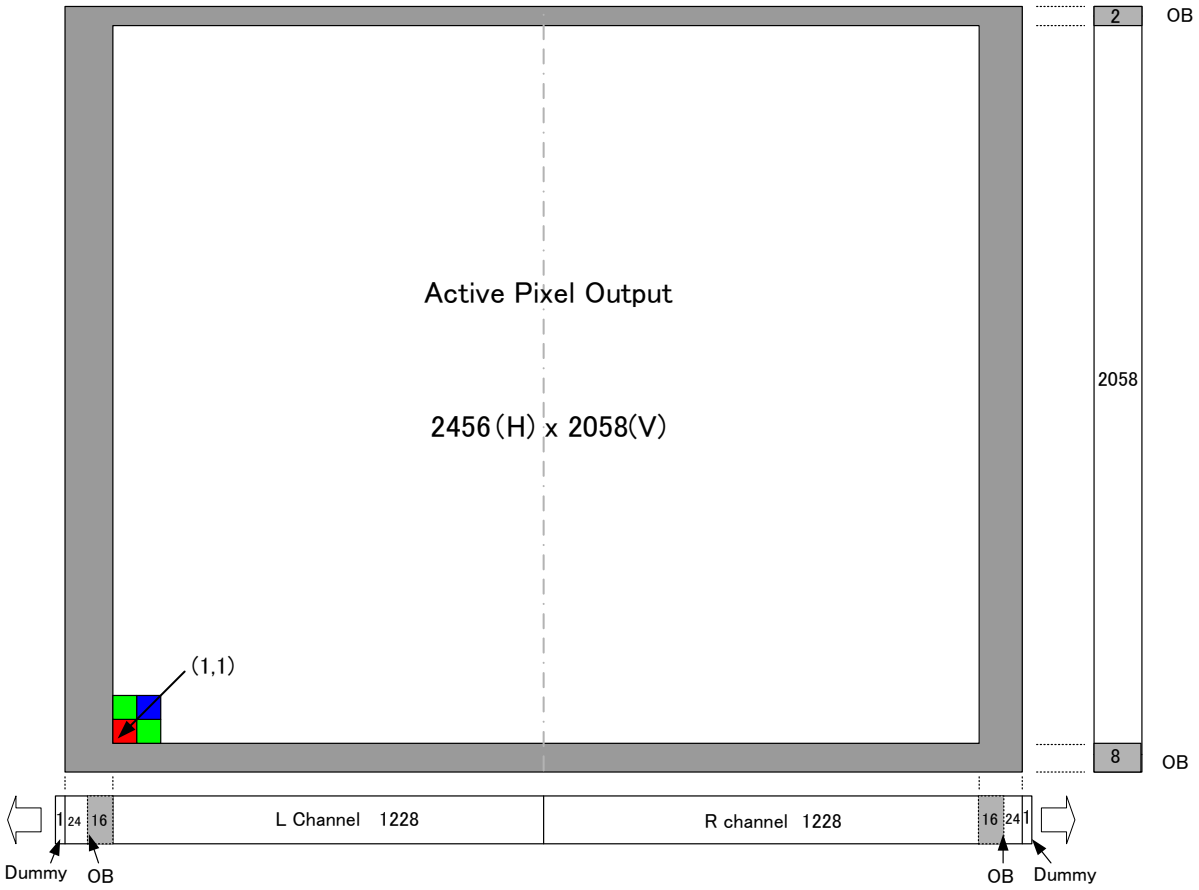


Fig. 13. CCD sensor layout

6.3.2. Horizontal timing

The LVAL period is shown for continuous mode.

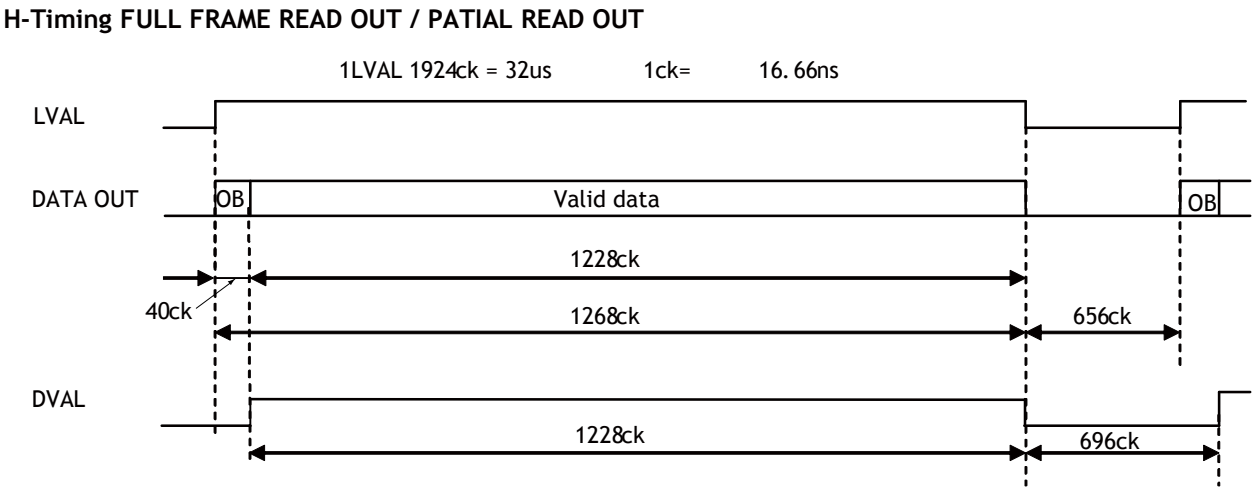


Fig. 14. Horizontal timing

6.3.3. Vertical timing

The FVAL period for continuous mode full scan is shown.

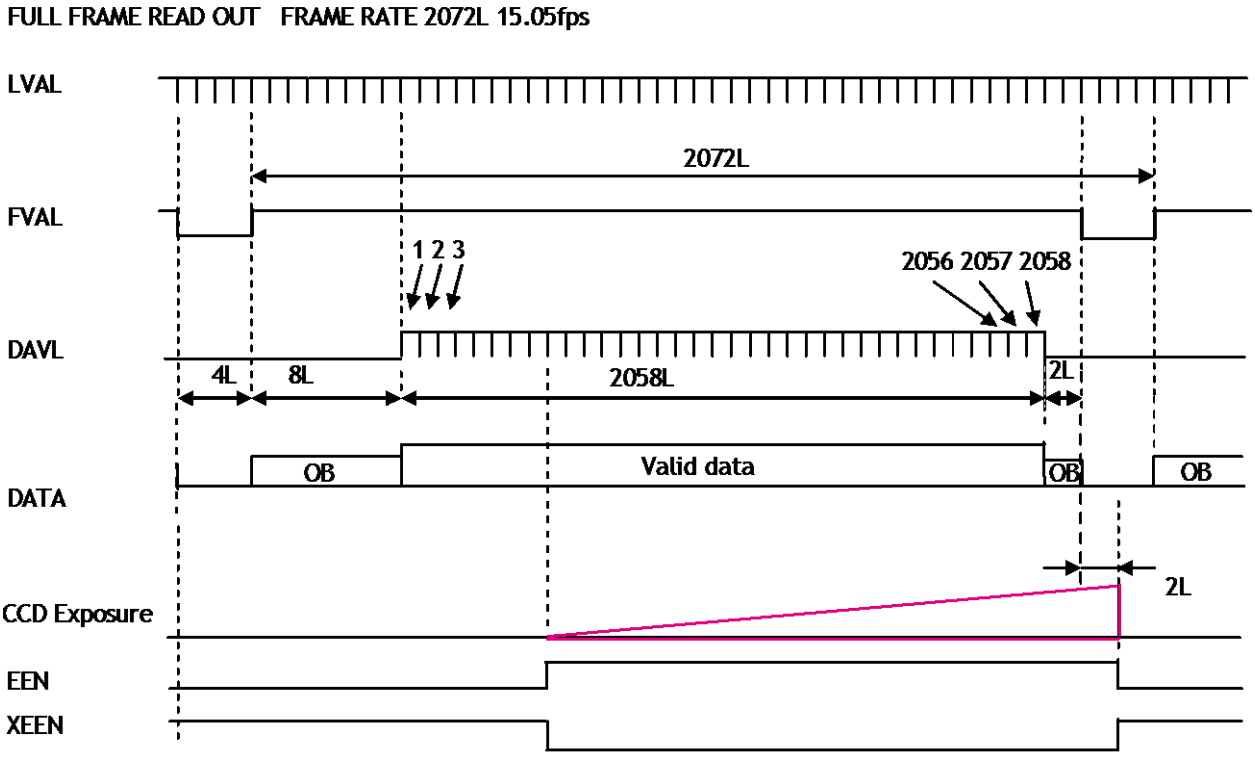
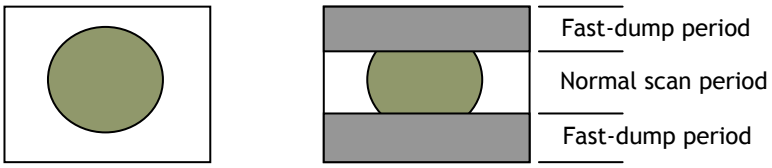


Fig. 15. Vertical timing for full scan

6.3.4. Partial Scan

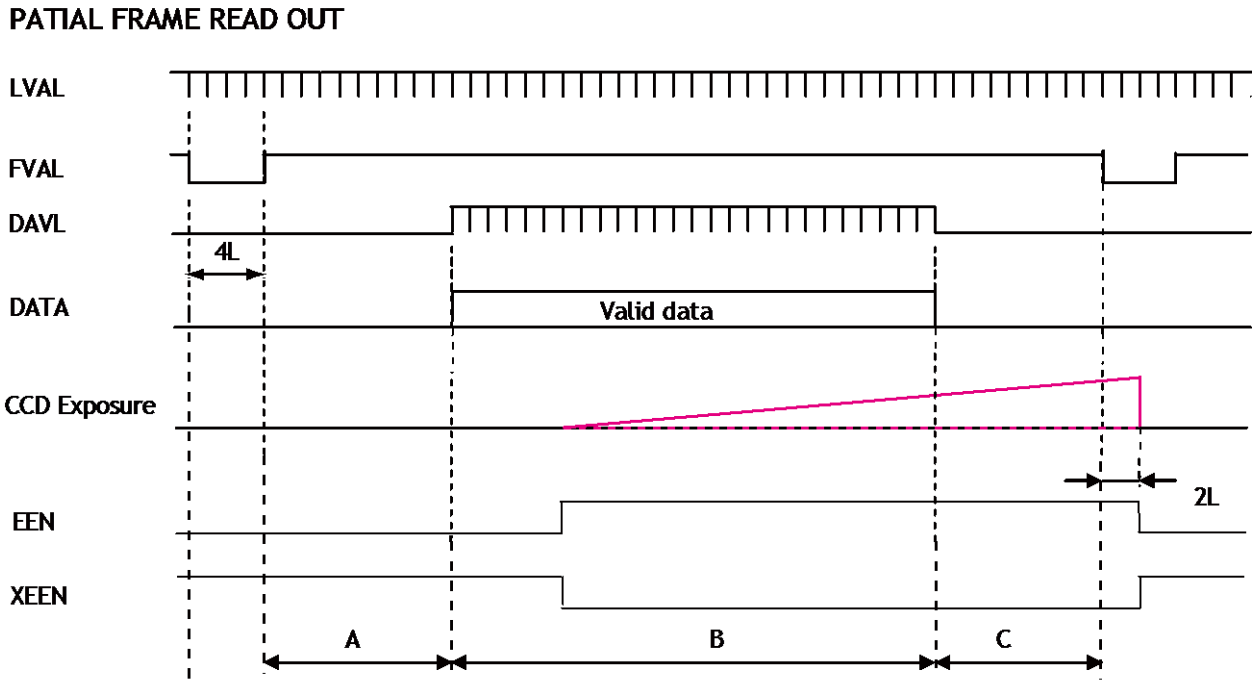
Partial scan allows higher frame rate by reading out a smaller center portion of the image. This is particularly useful when inspecting objects that do not fill the whole height of the image.



Full scan Partial scan

Vertical Timing

The below diagram and table provide vertical timing information for the fixed partial scan settings 1/2, 1/4, 1/3 and 2/3



Values for vertical timing in partial scan continuous mode.

AREA	FVAL Low (L)	A (L)	B (L)		C (L)	Total line (L)	frame rate (L)
			Start line	End line			
1/2	4	176	1030		93 L	1303 L	23.93
			515	1544			
1/4	4	262	514		136 L	918 L	34.04
			773	1286			
1/8	4	304	258		158 L	724 L	43.07
			901	1158			
2/3	4	118	1374		65 L	1561 L	19.97
			343	1716			

Remark! The color sequence for BB-500CL differs in partial scan. Refer to chapter 6.1.7.

Fig. 16. Vertical timing for partial scanning

Horizontal Timing
The horizontal timing is the same the full scanning.

H-Timing FULL FRAME READ OUT / PATIAL READ OUT

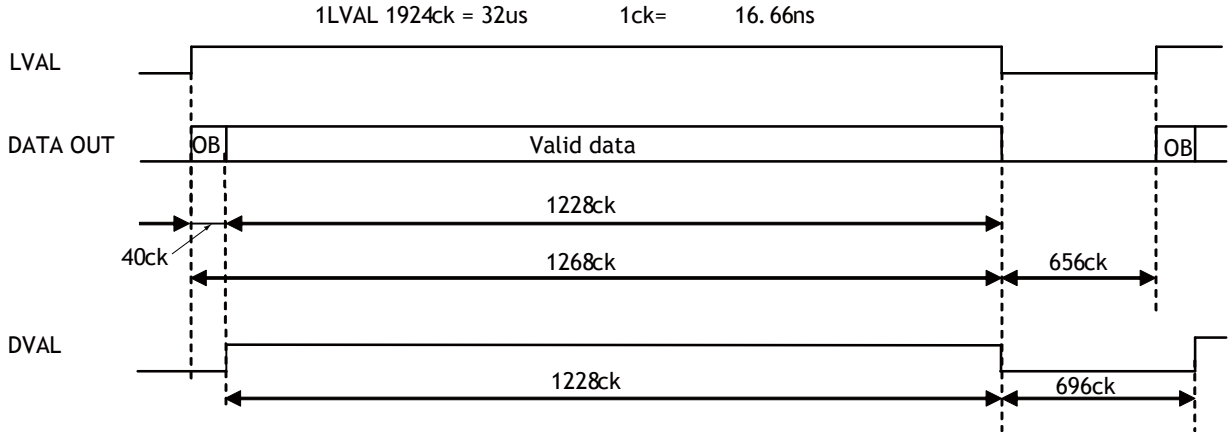


Fig. 17. Horizontal timing for partial scanning

6.3.5. Vertical Binning

Vertical binning combines charge from two adjacent lines, reducing the vertical resolution to half and at the same time increasing frame rate and sensitivity. By activating this function, the frame rate is increased to 48.87 fps.
This function is available only for BM-500CL.

Important Note
Vertical Binning can not be used together with the Partial Scanning.

Horizontal Timing

H-Timing V binning

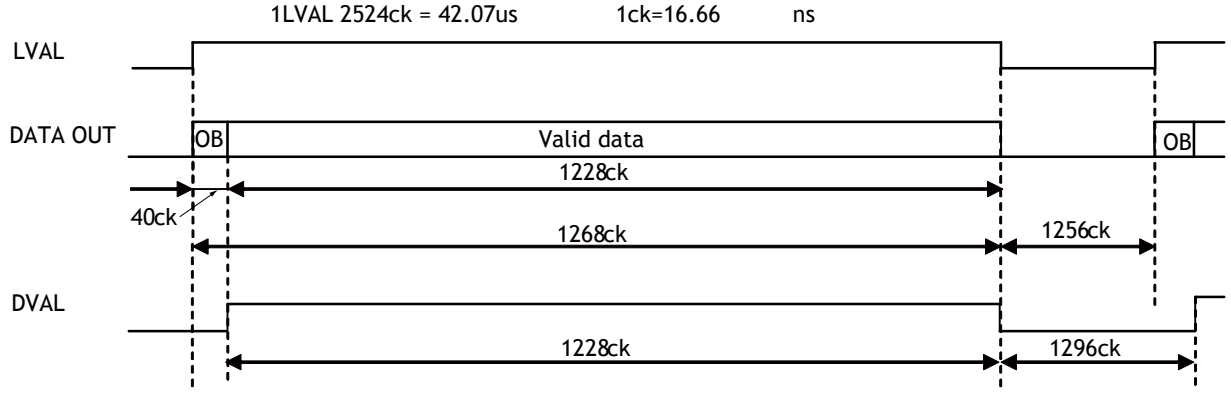


Fig.18. Horizontal Timing for Vertical Binning

Vertical timing

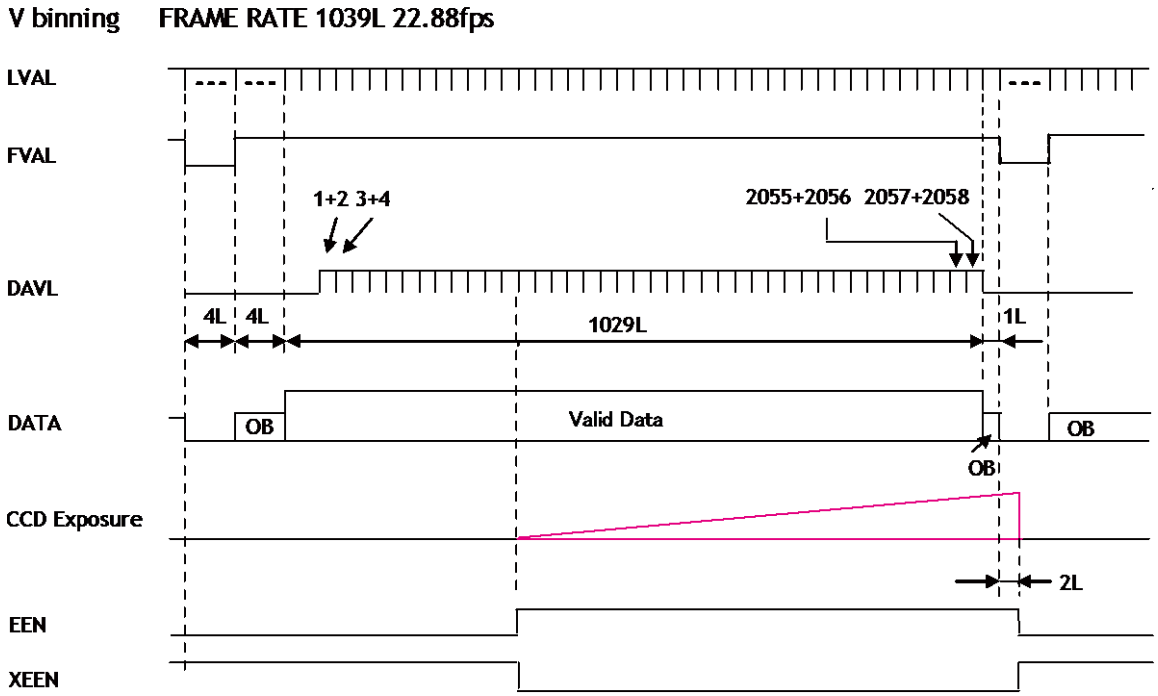


Fig.19. Vertical Timing for Vertical Binning

6.3.6. Decimation readout (Draft) mode

The draft mode reads out 4 lines out of every 16 lines. The frame rate is 37.54 frames per a second.

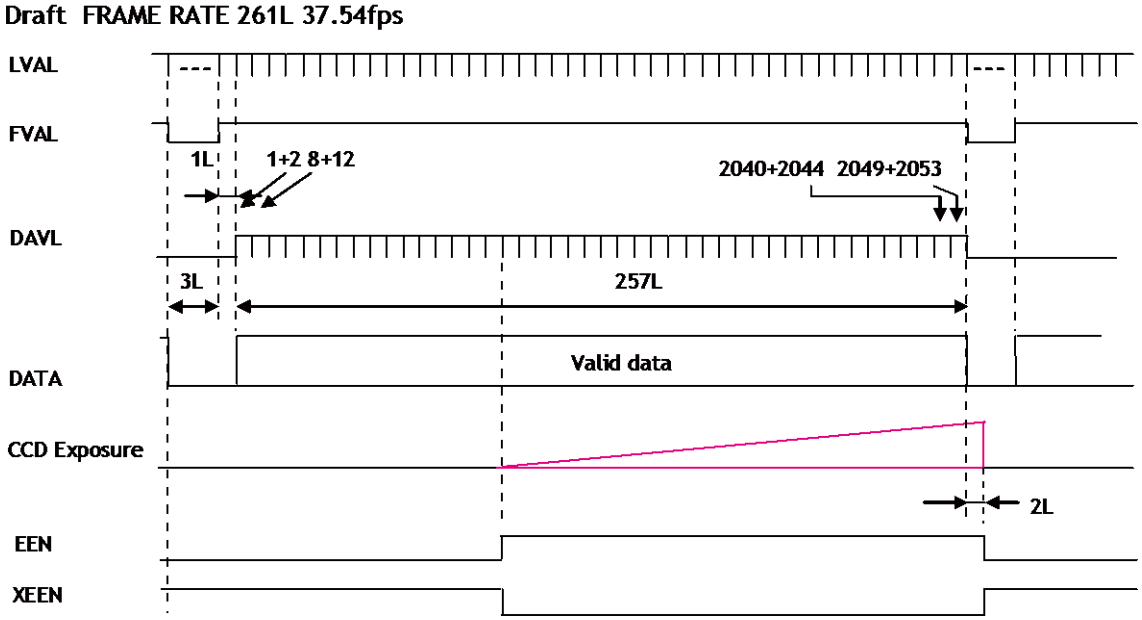


Fig.20. Vertical Timing for Draft Mode

6.4. Operation Modes

This camera can operate in 3 primary modes.

1.	***TR=0***	*Continuous Mode.*	Pre-selected exposure.
2.	***TR=1***	*Pre-select Mode.*	Pre-selected exposure.
3.	***TR=2***	*Pulse Width Mode.*	Pulse width controlled exposure.

6.4.1. Continuous operation

For applications not requiring asynchronous external trigger, but should run in continuous operation, this mode is used.
For timing details, refer to fig. 14 through fig. 19.

To use this mode:

Set function:	Trigger mode to “Continuous”.	TR=0
	Scanning	SC=0 through 5
	Programmable Partial	PRGP=1
	V Binning	VB=0 or 1
	Shutter mode pre-set or programmable	SM=0 or 1
	Shutter speed or	SH=0 to 10
	Programmable exposure	PE=2 to 2072
	Auto shutter	ASC=0 or 1
	Other functions and settings	

6.4.2. Pre-select Trigger Mode

An external trigger pulse initiates the capture, and the exposure time (accumulation time) is defined by the SH or PE commands.
The resulting video signal will start to be read out after the selected shutter time.

For timing details, refer to fig. 14 through fig. 19 and fig. 20 & 21.

To use this mode:

Set function:	Trigger mode to “Edge pre-select”.	TR=1
	Scanning	SC=0 to 5
	Programmable Partial	PRGP=0 or 1
	V Binning	VB=0 or 1
	Shutter mode to pre-set or programmable	SM=0 or 1
	Shutter speed or	SH=0 to 10
	Programmable exposure	PE=2 to 2072
	Auto shutter	ASC=0 or 1
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12-pin Hirose	TI=0, TI=1

Important notes on using this mode

1. The minimum trigger duration >2 LVAL.
2. Depending on the timing of the leading edge of the trigger pulse in relationship to FVAL, accumulation will be synchronous or a-synchronous in relationship to LVAL. See chapter 6.1.6. for details.
3. The minimum interval of the trigger is as follows (in case of LVAL sync). In LVAL async mode, the exposure period should be added.

Full	2/3	1/2	1/4	1/8	VBinning
2077	1566	1308	921	729	1043

LVAL sync timing

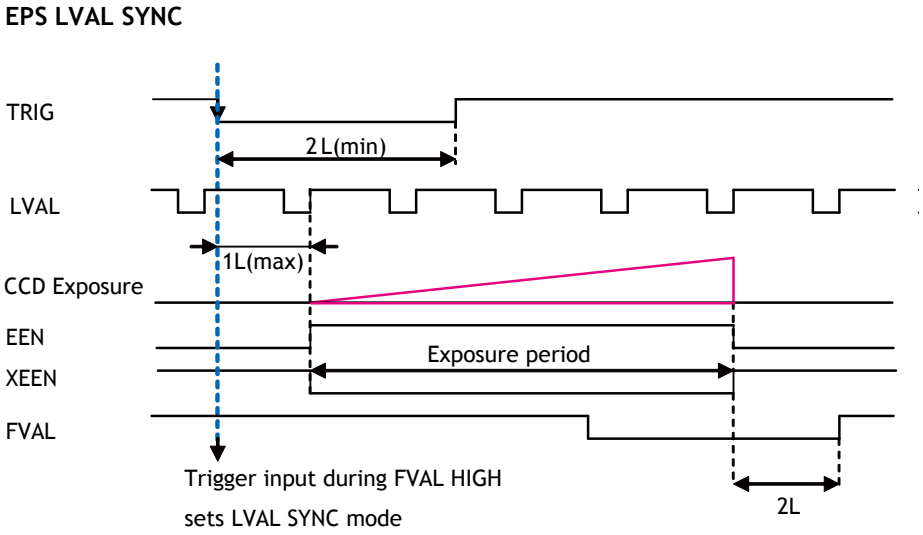


Fig. 21. Pre-select trigger mode. LVAL synchronized.

LVAL async timing

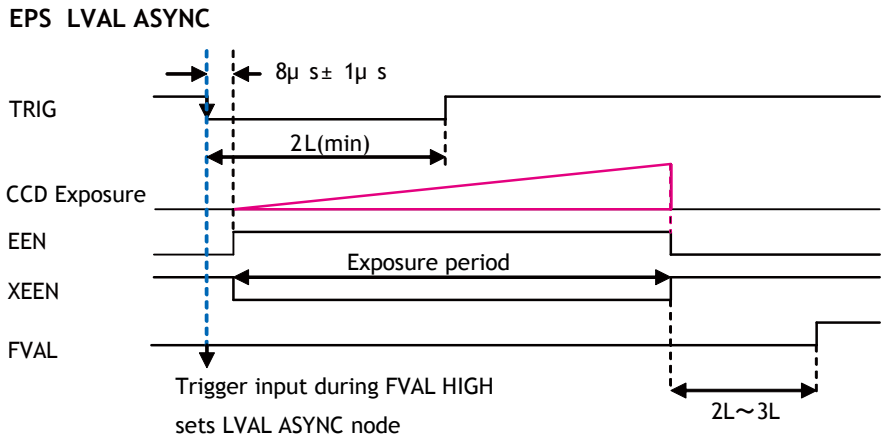


Fig.22. Pre-select trigger mode. LVAL a-synchronous

6.4.3. Pulse Width Trigger Mode

In this mode the accumulation time is equal the trigger pulse width. Here it is possible to have long time exposure. The maximum recommended time is <60 frames.

For timing details, refer to fig. 14 through fig. 19 and fig. 22 & 23.

To use this mode:

Set function:	Trigger mode to “Pulse width control”.	TR=2
	Partial scan	SC=0 to 5
	Programmable Partial	PRGP-0 or 1
	Vertical binning	VB= 0 or 1
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12-pin Hirose	TI=0, TI=1

Important notes on using this mode

1. The minimum trigger duration > 1 LVAL (LVAL async), > 2 LVAL (LVAL sync)
2. Depending on the timing of the leading edge of the trigger pulse in relationship to FVAL, accumulation will be synchronous or a-synchronous in relationship to LVAL. See chapter 6.1.6 for details.
3. The minimum interval of the trigger is as follows (in case of LVAL sync). In LVAL async mode, the exposure period should be added.

Full	2/3	1/2	1/4	1/8	V-binning
2077	1566	1308	921	729	1043

LVAL sync timing

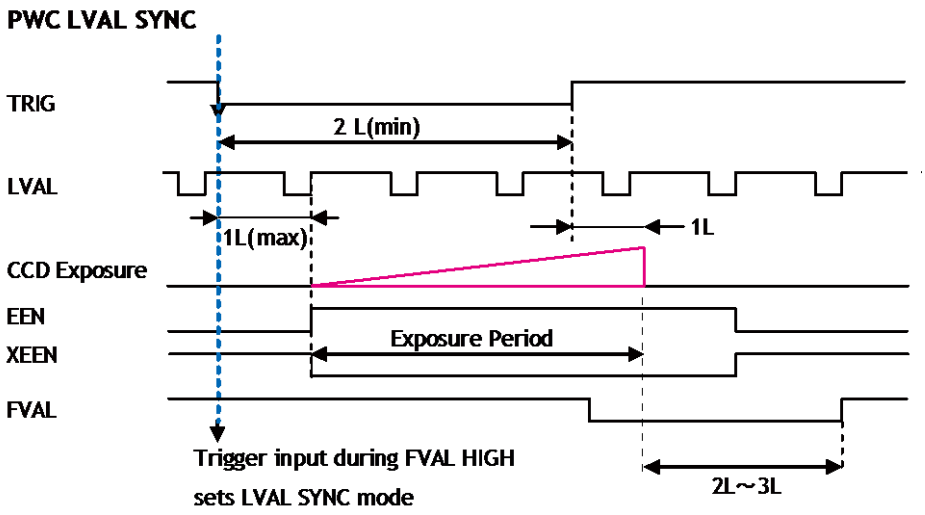


Fig. 23. Pulse width trigger mode. LVAL synchronized.

LVAL async timing

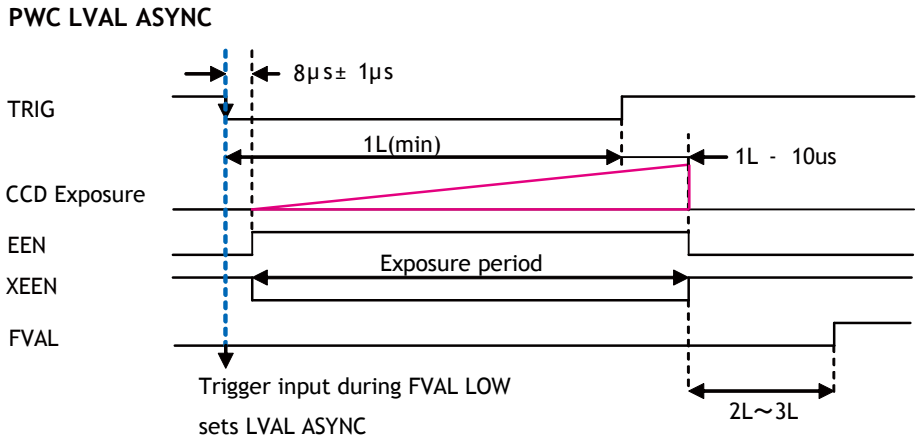


Fig.24. Pulse Width trigger mode. LVAL a-synchronous

6.5. Mode and function matrix.

The following table shows which functions will work in the different modes for BM-500CL / BB-500CL.

Trigger mode \ Func		Shutter			Partial	Binning	Accumulation	Iris video
		Pre-set	Programmable	Auto Shutter			LVAL sync / async	output
Cont.	**TR=0**	○	○	○	○	○	-	○
EPS	**TR=1**	○	○	×	○	○	Auto	-
PWC	**TR=2**	—	—	×-	○	○	Auto	-

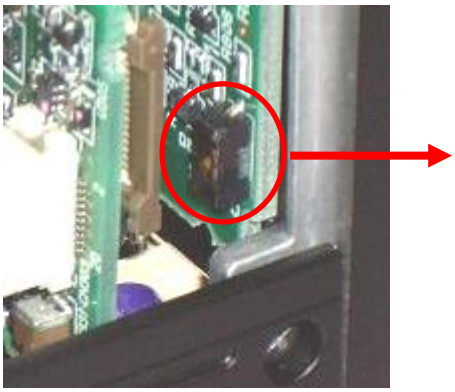
Fig. 24. Mode and function matrix.

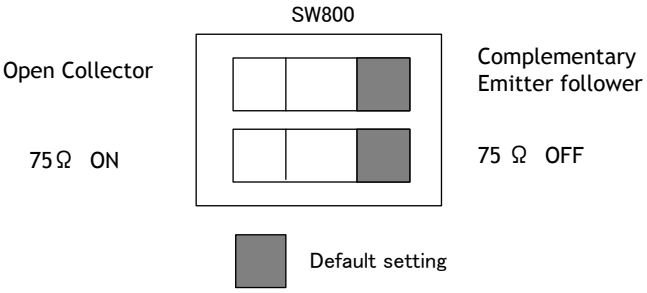
7. Configuring the Camera

7.1. DIP switch SW-800

This switch has following functions.
1. Select the circuit for WEEN output at pin 9 of the Hirose connector.
2. Enable/Disable 75 ohm termination for the trigger input, pin 10 on the Hirose connector.

The switch can be accessed by removing the top cover. The defaults are shown in the below diagram.





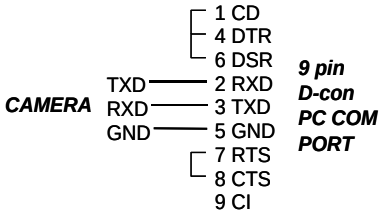
7.2. RS-232C control

All configuration of the BM-500CL / BB-500CL camera is done via the serial communication in the Camera Link connector. The camera can be set up from a PC running terminal emulator software, or using JAI's camera control software.
Below is the description of the ASCII based short command protocol.

Communication setting.

Baud Rate	9600 bps
Data Length	8 bit
Start Bit	1 bit
Stop Bit	1 bit
Parity	None
Xon/Xoff Control	None

RS 232C cable



Protocol.

Transmit setting to camera:
NN=[Parameter]<CR><LF> (NN is any kind of command. Capital or small letters.)
The camera answers:
COMPLETE<CR><LF>

To have all communication visible on the emulator screen, start with:
EB=1<CR><LF>
The camera answers:
COMPLETE<CR><LF>

Transmit request command to camera:
NN?<CR><LF> (NN is any kind of command.)
The camera answers:
NN=[Parameter]<CR><LF>

Transmit the following to have the camera actual setting:
ST?<CR><LF>
The camera answers:
A complete list of the current settings

Transmit the following to have a command list:
HP?<CR><LF>
The camera answers:
A list with all commands and possible settings

Invalid parameters send to camera: (99 is an invalid parameter)
SH=99<CR><LF>
The camera answers:
02 Bad Parameters!!<CR><LF>

To see firmware number.
VN?<CR><LF>
To see camera ID. It shows the manufacturing lot number.
ID?<CR><LF>

7.3. Setting functions

7.3.1. Bit allocation. BA=0, BA=1, BA=2

This command sets the output for 8-bit , 10-bit or 12-bit.

7.3.2. Partial scan. SC=0 through 4 / Draft mode SC=5

The CCD scanning format can be selected between full or partial scanning. With partial scanning only the vertical central part of the CCD sensor is read out with a higher frame rate. The partial scan is done by a fast dump read out of the lines in the vertical CCD register down to the top of the partial image. This central part of the image is read out with normal speed. The lines below the partial image are read out and dumped with a high speed. Refer to the Chapter 6.2.4.
When SC is set at " 5 " , the Draft mode can be activated. Refer to the Chapter 6.1.9.

7.3.3. Variable (Programmable) Partial PRGP=0,1 , STL=2 to 2058, ETL = 2 to 2058

The variable partial scan can set the start line and the end line of the scan to capture the necessary portion of the object.

7.3.4. Vertical binning. VB=0, VB=1

This function is only for BM-500CL camera.
The BM-500CL has only vertical binning mode. With V binning the pixel charge from 2 adjacent lines are added together in the horizontal CCD register. It is done by double pulses to the vertical CCD register. V Binning can not be used together with the Partial scanning.

7.3.5. Shutter mode. SM=0 and SM=1

With SM=0 this function selects the shutter from the 9 fixed steps (SH=0 through SH=9SH).
With SM=1 from programmable in 2071 steps (PE=2 through PE=2072).

7.3.6. Trigger input select. TI=0, TI=1.

This function selects the trigger input to be through Camera Link (TI=0), or as TTL through the 12 pin Hirose connector (TI=1).

7.3.7. Trigger polarity. TP=0, TP=1.

The active trigger polarity is normal low (TP=0). It can be invert it to active high (TP=1).

7.3.8. Gain level. GA=-84 through +336.

GA=0 is 0dB gain, which is normal working point. The range is from -3 dB to +12 dB.

7.3.9. Black level. BL=0 through BL=1023.

Black level (or set-up level) will set the video level for black. Factory setting is 128 LSB for 12 bit, 32 LSB for 10bit or 8 LSB for 8bit.

7.4. Save and Load Functions.

The following commands are for store and load camera settings in the camera EEPROM.

Load settings. *LD*.
This command will load previous stored settings to the camera. 3 user settings can be stored in the camera EEPROM. 1 factory setting is also stored in the camera. The settings stored in the last used user area is used as default settings at power up.

Save Settings. *SA*.
This command will store the actual camera settings to 1 of the 3 user area in the camera EEPROM.

EEPROM Area. *EA*.
If received, the camera will return the last used user area number.

7.5. BM-500CL / BB-500CL command list

	Command Name	Format	Parameter	Remarks
A - General settings and utility commands.				
1	Camera Status Request	**ST**?<CR><LF>		Actual setting
2	Firmware Version	**VN**?<CR><LF>		3 digits (e.g.) 100 = Version 1.00
3	Camera ID Request	**ID**?<CR><LF>		max 12 characters
4	Model Name Request	**MD**?<CR><LF>		max 12 characters
5	User ID	**UD**=[Param.]<CR><LF> UD?<CR><LF>		User can save and load free text.(12 or less characters)
6	Error Code	**ERROR**=[Param.]<CR><LF> ERRER?<CR><LF>	O=Not completed yet 1=Succeeded 2=Error 1, G ch image too bright 3=Error 2, G ch image too dark 4=Error 3, Time out error	One of values is back from camera
B - Shutter				
1	Shutter Mode	**SM**=[Param.]<CR><LF> SM?<CR><LF>	0=Preset Shutter 1=Programmable exposure	
2	Preset Shutter	**SH**=[Param.]<CR><LF> SH?<CR><LF>	0=Off, 1=1/60, 2=1/100, 3=1/250, 4=1/500, 5=1/1000, 6=1/2000, 7=1/4000, 8=1/8000, 9=1/10000	Available when SM=0.
3	Programmable Exposure	**PE**=[Param.]<CR><LF> PE?<CR><LF>	**2** to **2072** (BM/BB-500)	Available when SM=1.
C - Trigger mode				
1	Trigger Mode	**TR**=[Param.]<CR><LF> TR?<CR><LF>	0=Normal (Continuous) 1=EPS(Pre select) 2=PWC(Pulse width)	
2	Trigger Polarity	**TP**=[Param.]<CR><LF> TP?<CR><LF>	0=Active Low 1=Active High	
3	Trigger Input	**TI**=[Param.]<CR><LF> TI? <CR><LF>	0=Camera Link 1=Hirose 12pin	
D -Image Format				
1	Bit Allocation	**BA**=[Param.]<CR><LF>	0=8bit, 1=10bit, 2=12bit	

	Command Name	Format	Parameter	Remarks
		BA?<CR><LF>		
2	Scan Format	**SC**=[Param.]<CR><LF> SC? <CR><LF>	0=Full Frame 1=2/3 Partial 2=1/2 Partial 3=1/4 Partial 4=1/8 Partial 5=Decimation (Draft)	
3	V-Binning	**VB**=[Param.]<CR><LF> VB?<CR><LF>	0=OFF 1=On	Only for BM-500CL
4	Variable partial scan	**PRGP**=[Param.]<CR><LF> PRGP?<CR><LF>	0=OFF 1=ON	For Programmable partial
5	Start line	**STL**=[Param.]<CR><LF> STL?<CR><LF>	2 to 2058	For Programmable partial
6	End line	**ETL**=[Param.]<CR><LF> ETL?<CR><LF>	2 to 2058	For Programmable partial
E - Gain, Black and signal settings				
1	Gain Level	**GA**=[Param.]<CR><LF> GA?<CR><LF>	-84 to 336	
2	Gain Adjust 2	**GJUT2**=[Param.]<CR><LF> GJUT2?<CR><LF>	-84 to 84	Invalid when Tap Balance Auto is set to ON
3	Gain Mode	**AGC**=[Param.]<CR><LF> AGC?<CR><LF>	0= Manual Gain Control 1=Auto Gain Control	
4	ALC Reference	**AGCF**=[Param.]<CR><LF> AGCF?<CR><LF>	0 to 1023	
5	Black Level	**BL**=[Param.]<CR><LF> BL?<CR><LF>	255 to 767	
6	Analogue Base gain	**CDSGA**=[Param.]<CR><LF> CDSGA?<CR><LF>		
7	User Black set up1	**BLS**=[Param.]<CR><LF> BLS?<CR><LF>	-511 to 511	For AFE1 Invalid when Tap Balance Auto is set to ON
8	User Black set up 2	**BLS2**=[Param.]<CR><LF> BLS2?<CR><LF>	-511 to 511	For AFE2 Invalid when Tap Balance Auto is set to ON
9	Black fine	**BLF2**=[Param.]<CR><LF> BLF2?<CR><LF>	-255 to 256	For AFE2 Invalid when Tap Balance Auto is set to ON
10	IRIS Adjust Level	**IAL**=[Param.]<CR><LF> IAL?<CR><LF>	-31 to 32	TYP : 0

	Command Name	Format	Parameter	Remarks
F - AWB, LUT and others				
1	AWB mode	**AWBM**=[Param.]<CR><LF> AWBM?<CR><LF>	0=One push 1=3200K 2=4600K 3=5600K	Only for BB-500CL
2	One Push AWB	**AWB**=[Param.]<CR><LF>	1=Run	Only for BB-500CL
3	One Push AWA	**AWA**=[Param.]<CR><LF>	1=Run	Invalid when Tap Balance Auto is set to ON
4	One Push ABA	**ABA**=[Param.]<CR><LF> ABA?<CR><LF>	1=Run	Invalid when Tap Balance Auto is set to ON
5	Auto Shutter Control	**ASC**=[Param.]<CR><LF> ASC?<CR><LF>	0=OFF; 1=ON	
6	Channel 1 area	**CHA1**=[Param.]<CR><LF> CHA1?<CR><LF>	0= Full,1=Low right, 2=Low left, 3=Low,4=Middle Right, 5=Middle, 7=High, 8=Mid. left,16=High Right,32=High Left	
7	LUT Control	**LUTC**=[Param.]<CR><LF> LUTC?<CR><LF>	0=OFF; 1=ON	
8	LUT data communication	**LUT1**=[Param.]<CR><LF> LUT1?<CR><LF>	0.45, LUT (256)	Serial comm.. 256 data
9	LUT data communication	**LUT2**=[Param.]<CR><LF> LUT2?<CR><LF>	Transmit LUT2=1 after 256 data transmission	
10	Send gamma coefficient	**GAMA**=[Param.]<CR><LF>	4096=Linear ,1843=0.45	
11	Test Pattern	**TPN**=[Param.]<CR><LF> TPN?<CR><LF>	0=OFF 2=Horizontal grey 3=Vertical grey 4=Moving grey 5=Color bar 1 6=Color bar 2 7=Moving Color bar	
12	Pixel Offset switch	**POS**=[Param.]<CR><LF> POS?<CR><LF>	0=OFF, 1=ON	For BB-500CL
13	Pixel Gain switch	**PGS**=[Param.]<CR><LF> PGS?<CR><LF>	0=OFF, 1=ON	For BB=500CL
14	Pixel Gain R1	**PGR**=[Param.]<CR><LF> PGR?<CR><LF>	0 to 16384	For AFE1(Only for BB-500CL) Invalid when Tap Balance Auto is set to ON
15	Pixel Gain GR1	**PGGR**=[Param.]<CR><LF> PGGR?<CR><LF>	0 to 16384	For AFE1(Only for BB-500CL) Invalid when Tap

	Command Name	Format	Parameter	Remarks
				Balance Auto is set to ON
16	Pixel Gain B1	**PGB**=[Param.]<CR><LF> PGB?<CR><LF>	0 to 16384	For AFE1(Only for BB-500CL) Invalid when Tap Balance Auto is set to ON
17	Pixel Gain GB1	**PGGB**=[Param.]<CR><LF> PGGB?<CR><LF>	0 to 16384	For AFE1(Only for BB-500CL) Invalid when Tap Balance Auto is set to ON
18	Pixel Gain R2	**PGR2**=[Param.]<CR><LF> PGR2?<CR><LF>	0 to 16384	For AFE2(Only for BB-500CL) Invalid when Tap Balance Auto is set to ON
19	Pixel Gain GR2	**PGGR2**=[Param.]<CR><LF> PGGR2?<CR><LF>	0 to 16384	For AFE2(Onlt for BB-500CL) Invalid when Tap Balance Auto is set to ON
20	Pixel Gain B2	**PGB2**=[Param.]<CR><LF> PGB2?<CR><LF>	0 to 16384	For AFE2(Only for BB=500CL) Invalid when Tap Balance Auto is set to ON
21	Pixel Gain GB2	**PGGB2**=[Param.]<CR><LF> PGGB2?<CR><LF>	0 to 16384	For AFE2(Only for BB-500CL) Invalid when Tap Balance Auto is set to ON
22	ChannelBalance Adjust Pixel Gain R	**RPGR=[Param.]<CR><LF>** RPGR?<CR><LF>	3686 to 4506	for Digital Gain (Only BB-500CL)
23	ChannelBalance Adjust Pixel Gain G	**RPGG=[Param.]<CR><LF>** RPGG?<CR><LF>	3686 to 4506	for Digital Gain BM-500CL:Ych BB-500CL:Gch
24	ChannelBalance Adjust Pixel Gain B	**RPGB=[Param.]<CR><LF>** RPGB?<CR><LF>	3686 to 4506	for Digital Gain (Only BB-500CL)
25	ASC Min Value	**ASMIN=[Param.]<CR><LF>** ASMIN?<CR><LF>	125 to 2071	
26	ASC Max Value	**ASMAX=[Param.]<CR><LF>** ASCMAX?<CR><LF>	125 to 2072	
27	AGC Min Value	**AGMIN=[Param.]<CR><LF>**	-84 to 671	

	Command Name	Format	Parameter	Remarks
		RPGB?<CR><LF>		
28	AGC Max Value	**AGMAX=[Param.]<CR><LF>** AGMAX?<CR><LF>	0 to 672	
29	ASC Speed	**ASCSP=[Param.]<CR><LF>** ASCSP?<CR><LF>	1 to 16	
30	AGC Speed	**AGCSP=[Param.]<CR><LF>** AGCSP?<CR><LF>	1 to 16	
31	Tap Balance Auto	**TBA=[Param.]<CR><LF>** TBA?<CR><LF>	0=off, 1=on	
32	Auto Iris Lens Control Signal Output	**AIC=[Param.]<CR><LF>** AIC?<CR><LF>	0=off, 1=on	
33	Temperature	TMP0?<CR><LF>	0 to 0xFFF8 (/ 128 → °C)	
G - Saving and loading data in EEPROM				
1	Load Settings (from Camera EEPROM)	**LD**=[Param.]<CR><LF>	0=Factory area 1=User 1 area 2=User 2 area 3=User 3 area	Latest used DATA AREA becomes default at next power up.
2	Save Settings (to Camera EEPROM)	**SA**=[Param.]<CR><LF>	1=User 1 area 2=User 2 area 3=User 3 area Note : parameter 0 is not allowed	
3	EEPROM Current Area No Request.	**EA**?<CR><LF>	0=Factory area 1=User 1 area 2=User 2 area 3=User 3 area	The camera return the latest used DATA AREA.

NOTE: Do not try to use commands not shown in this list.

8. Camera Control Tool for BM-500CL / BB-500CL

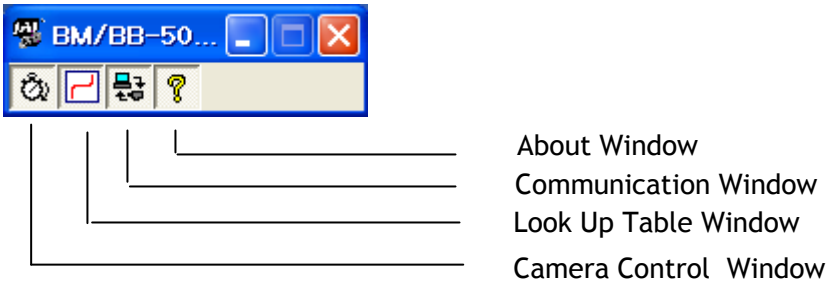
The Camera Control Tool for Windows 2000/XP can be downloaded from www.jai.com.
The control tool contains a camera control program and a developer's kit for integrating the control tool in your own software. For the integrator and experienced user, the Camera Control Toll is much more than a program with a window interface. It also provides an easy and efficient ActiveX interface built for MS Windows 2000/XP. The OCX interface has the ability to connect to the camera using the serial interface of the PC by reading and writing properties for the camera. This integration requires simple programming skills within Visual Basic, Visual C++ or similar languages in a Microsoft Windows environment.

8.1. Camera Control Tool Interface

The Camera Control Tool Software is based on a main Tool Bar and a number of associated Tool Windows. Each button in the Tool Bar pops up a separate Tool Window when pressed. The layout of the program can be adjusted by arranging the windows the way it is preferred. The program will store this information and recreate this layout, when the program is restarted. All Camera Control Tools have a Communication Window and an About Window. The other window(s) contains camera control commands.

8.1.1. Camera Control Tool Bar

This is a Camera Control Tool Bar and when the button of each widow, each control GUI can be initiated.

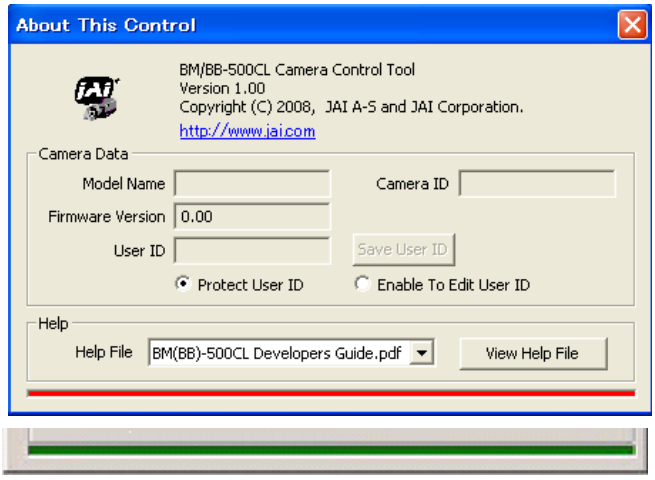


8.2. The About Window

The about window contains a picture of the camera and information about the version of the program, Internet connection to JAI A/S and access to the help documents.

The drop-down box labelled "Help File" will list all files which have the extension .pdf and that are found in the program (default) folder.

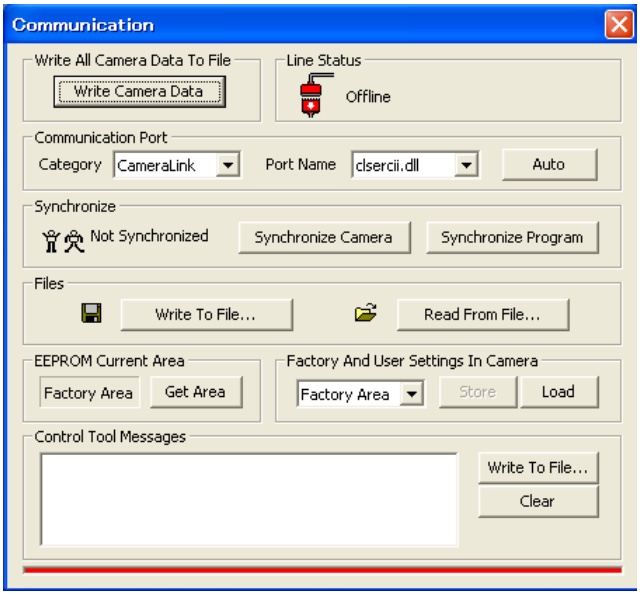
C:\Program Files\JAI A-S\"control tool name"



It is possible to download updated operation manuals from the jai website:
http://www.jai.com
An updated manual can be saved in the folder address mentioned above and it will automatically be included in the list of help files.

At the bottom of the windows (all windows but the Communication Window is a colored bar. The bar is green when the Camera Control Tool is connected to a camera and the camera is turned on. The bar is red when the Camera Control Tool is not connected to a camera or when the camera is turned off.

8.3. Communication Window



The Communication Window is used to connect the Camera Control Tool with the JAI camera.

Camera Link communication:
The 'Communication Port' list box also contains DLL file names (or frame grabber names) for all Camera Link frame grabbers that are installed in the pc. This is done by using a DLL file called "clserial.dll" to upload all frame grabber DLLs that are found in the pc.
Just select the option for the frame grabber that is installed in the pc.

Auto search
Click the auto button to search for a camera on communication port 1 to 16. The camera control program automatically sends camera request on every communication port. The user is prompted to use a communication port if a camera answers the request.
This button is only used for RS-232 communication.

Off/On-line mode
The Camera Control Tool Application can run Offline (without a camera attached) and all functions are fully functional in offline mode.
Off line mode is indicated in The Communication Window, where a status field with graphic and text indicates the on/off-line status.

Changing the selected communication port (from the communication window) changes the online/off-line status. If a camera is found on the selected communication port the application runs online otherwise offline.

Changing the settings in the application will automatically update the camera settings when the application is online.
If the application looses connection with the camera it will automatically go to offline mode and it is indicated in the communication window.

Synchronize program and camera
The Camera Control software has the ability to synchronize either the camera or the program. Click Synchronize camera to write all settings from the program to the camera or click the Synchronize program to load all settings from the camera to the program.

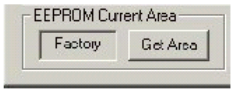
Files
When clicking the Write to File or Read from File button, the user is prompted for a file using a standard file dialog. New files are created if they do not already exist.

Files for camera settings have the extension cam. Information about the communication port is not stored in the files. All settings are automatically sent to the camera when a file has been loaded (if the camera is online).

Factory and User Settings
Use the Store button to store the current camera settings into the user settings area in EEPROM. Current camera settings are not saved when the camera is turned off. To save current camera settings you have to save them on the available user areas.
Use the Load button to restore previously saved camera settings from either the Factory or the User EEPROM area.

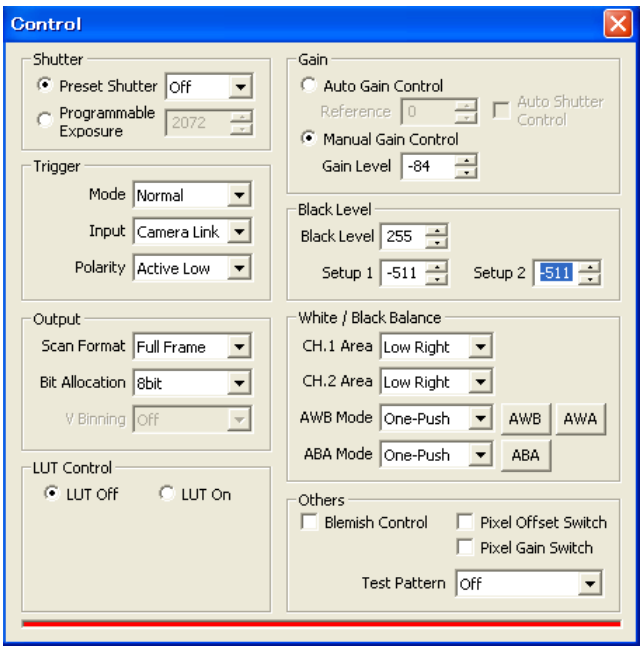
Write All Camera Data to File.
Click the "Write Camera Data" button to save all camera settings into a text file. The information that can be saved is:
Model Name, Camera ID, User ID, Firmware Version, Current Settings, Factory Settings and the available User Areas.
The file is formatted as shown in the picture below:

EEPROM Current Area.
Click the 'Get Area' button to read the power up settings area number.



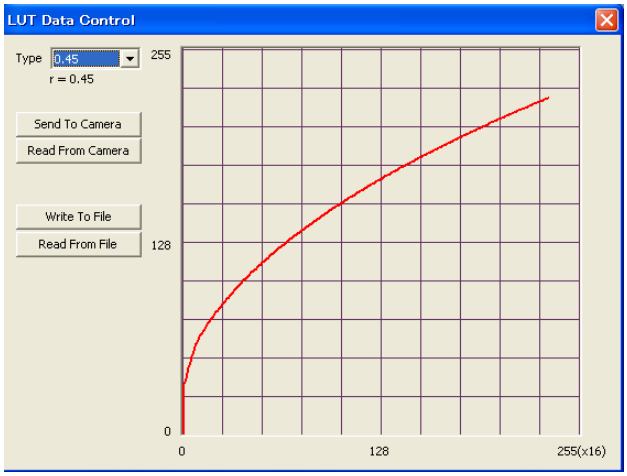
8.4. Camera Control Window

The Camera Control Window contains the fundamental camera setting functions.
It is possible to set the shutter mode, Trigger mode, image format, scan format, gain control and black setting.

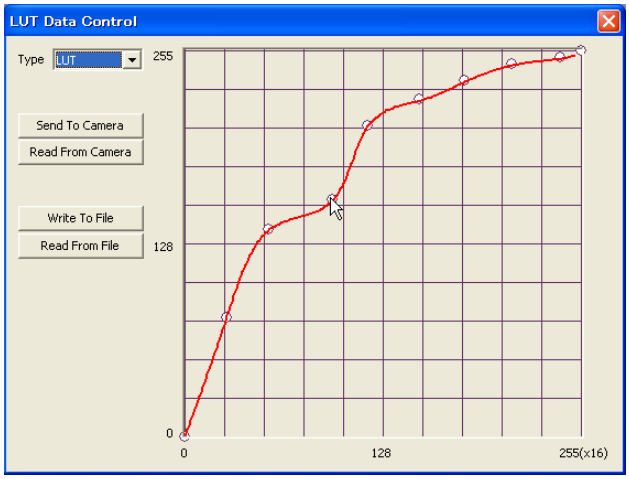


8.5. Look-up table (LUT)

Use this window for setting up the output characteristics. Gamma and Knee characteristics can be set. LUT contains γ=0.45 presetting and 256 data for optional settings.



Gamma = 0.45



LUT

8.6. Using the Camera Control Tool

Here is some practical information about the Camera Control Tool:

1. The Camera Control Tool bar is always on top of other windows.
2. When you minimize the Camera Control Tool bar all open windows will close.
3. It is possible to work with the Camera Control Tool when the camera is online and when the camera is offline.
4. The newer JAI cameras always start up with the last used user area (but for some old models it will start up with the last saved user area.)
5. The Camera Control Tool saves the last used settings (not the user area), which don't have to be the same as for the last saved user area.
6. The setup file 'CameraName.ini' stores all information about camera settings. When the program is started the last settings for the program are loaded from the file 'CameraName.ini'
7. When you turn on the camera and the Camera Control Tool, it is possible that the Camera Control Tool does not show the actual camera settings (see 4. and 5.).
    a. To obtain the camera settings click "Synchronize Program".
    b. To send the settings that are saved in the Camera Control Tool (last used settings) to the camera click "Synchronize Camera".
    c. To see which area the camera has started up in click "Get Area".

9. External Appearance and Dimensions

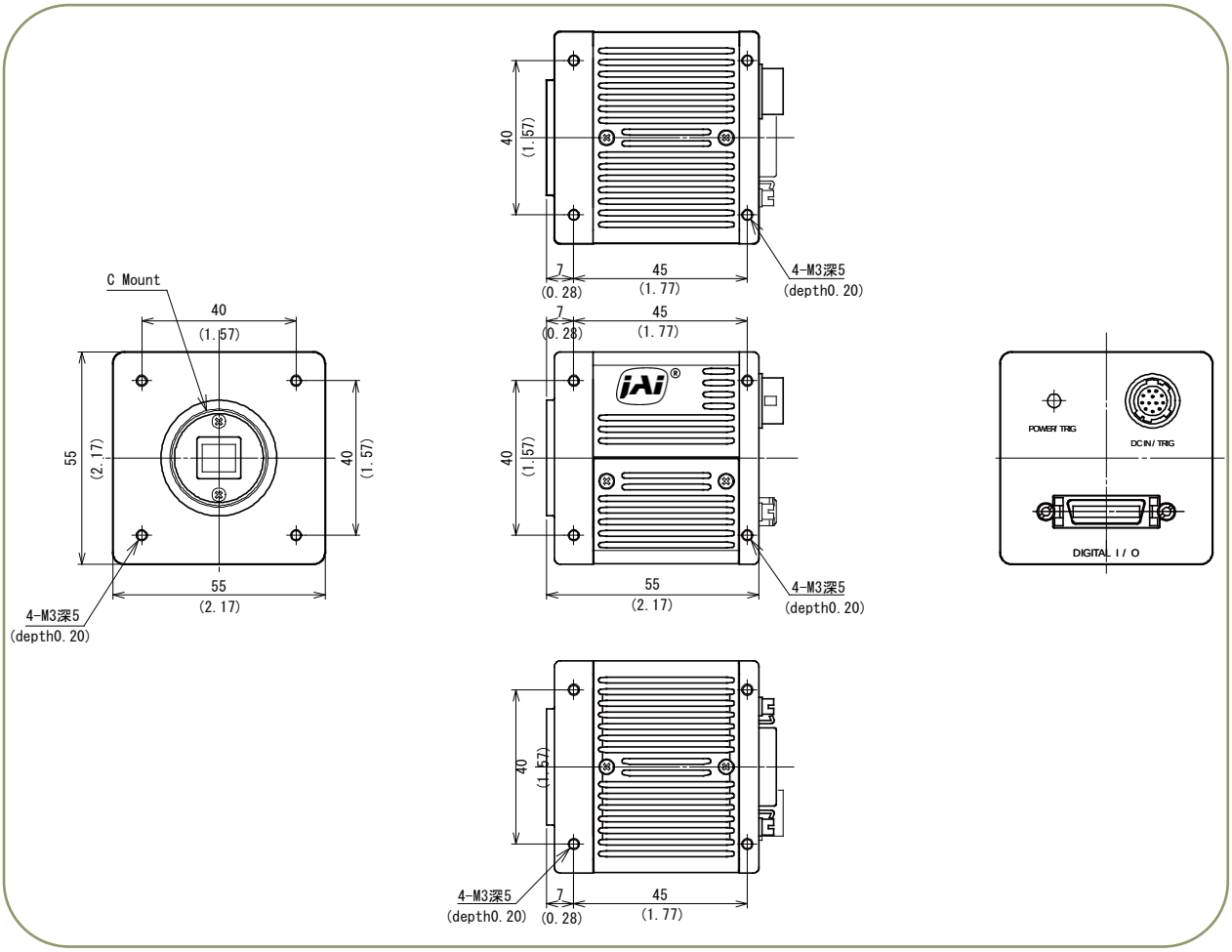


Fig. 25. Outline.

10. Specifications

10.1. Spectral response

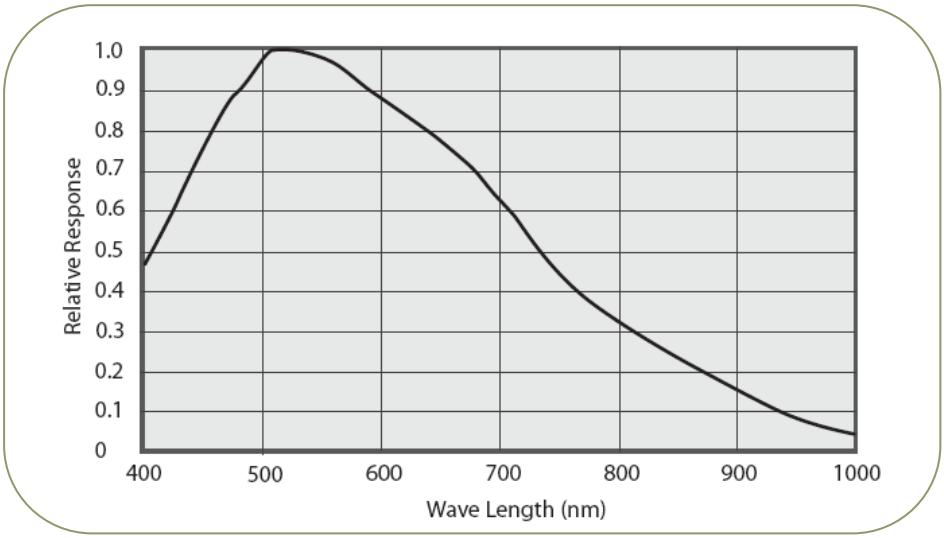


Fig. 26. Spectral response for BM-500CL

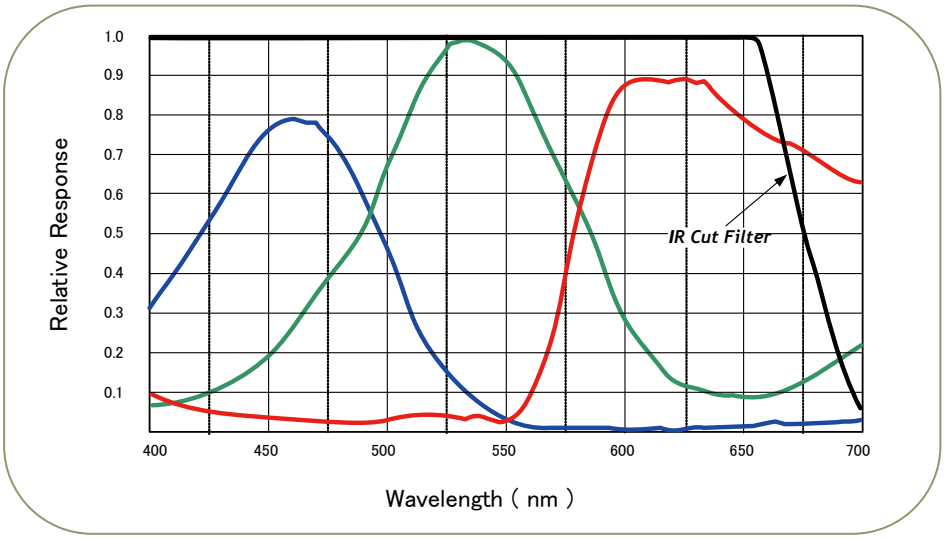


Fig.27. Spectral response for BB-500CL

10.2. Specification table

Specifications	BM-500CL	BB-500CL
Scanning system	Progressive scan	
Frame rate full frame	15.05 frames/sec. Progressive (2058 lines/frame)	
Pixel clock	60 MHz	
Line frequency	31.19 kHz (1L = 32.067 μs , 1924 pixel clock/line : L c h / R ch)	
CCD sensor	2/3". Monochrome ICX625ALA	2/3" Color ICX625AQA
Sensing area	8.47 h) x 7.10 (v) mm 2/3 inch diagonally	
Cell size	3.45 (h) x 3.45 (v) μm	
Active pixels	2456 (h) x 2058 (v)	
Pixels in video output. Full 2/3 partial 1/2 partial 1/4 partial 1/8 partial Programmable	2456 (h) x 2058 (v) 15.05 fps. H = 31.19 kHz 2456(h) x 1372 (v) 19.97 fps H= 31.19 kHz 2456 (h) x 1028(v) 23.93 fps. H = 31.19 kHz 2456 (h) x 514 (v) 34.04 fps. H = 31.19 kHz 2456 (h) x 258 (v) 43.07 fps. H = 31.19 kHz Start line , End line programmable set (2 to 2072)	
Vertical Binning	1/2 2456 (h) x1029 (v) 22.88 fps H = 23.76 KHz , 1L = 42.07 μs	-
Draft	2456 (h) x 261 (v), 37.54 fps, H = 9.79 KHz, 1L=102.066 μs,	
Sensitivity on sensor (minimum)	0.08 Lux (Max. gain, Shutter OFF, 50% video)	0.25 Lux (Max. gain, Shutter OFF,50% Green, w/IR cut filter)
S/N ratio	More than 50 dB (0dB gain)	
Digital Video output.	8, 10 or 12 bit in Camera Link	8, 10 or 12 bit raw Bayer video in Camera Link
Iris video output. Analogue	0.7 Vpp	
Gain	Gain Mode (CDS Gain): Low (Standard setting) and High (High sensitivity setting, Mono +6dB, Color +9dB) can be selected. Default is Low. Manual -3 to +24 dB AGC : -3 dB to + 24 dB (Cannot use together with Auto shutter) Operating speed can be adjusted, The upper or lower limit can be set	
Bayer white balance	One push auto : range from 2600K to 6500K Preset : 3200K, 4600K, 5600K	
Gamma Knee	Look up table (γ=1.0（Default）, 0.45、LUT: 256 points)	
Video Level Adjustment	Automatic Tap Balance : continuous Automatic white Balance Adjustment : Manual Automatic Black Level Adjustment : Manual Default setting : Automatic Tap Balance Continuous	
Synchronization	Int. X-tal.	
Trigger input. TTL Camera Link	4 V ±2 V. TTL Via Camera Link , LVDS	
EEN output	3 V from 75 Ω source	
Trigger modes	Pre-Select and Pulse Width	
Accumulation	LVAL synchronous or a-synchronous automatic selection	
Preset Shutter speed	OFF (1/15) , 10 fixed steps 1/30 to 1/10,000 second	
Programmable exposure	2 L to 2072 L (64.13 μs to 66.44 ms)	
Auto shutter	OFF to 1/250 s (Cannot use together with AGC)	
Pulse width control	1 L to 30 frames.	
Readout modes	Full, Partial scan.(2/3, 1/2, 1/4, 1/8, Programmable) ,V Binning Draft	Full, Partial scan.(2/3,1/2, 1/4,1/8, Programmable) , Draft

Specifications	BM-500CL	BB-500CL
Control interface	Camera Link serial	
Functions controlled by CL Serial	Shutter, Trigger, Scanning, Read out, Polarity, Black level, Gain,	
Operating temperature	-5°C to +45°C	
Humidity	20 – 80% non-condensing	
Storage temp/humidity	-25°C to +60°C/20% to 80% non-condensing	
Vibration	10G (20Hz to 200Hz, XYZ)	
Shock	70G	
Regulatory	CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE	
Power	12V DC ± 10%. 5.5W (Normal Operation)	
Lens mount	C-mount (Flange back 17.526 mm -0.05mm) Image centre ±0.1mm from C-mount centre	
Dimensions	55 x 55 x 55 mm (HxWxD)	
Weight	200 g	200 g

Note: Above specifications are subject to change without notice

11. Appendix

11.1. Precautions

Personnel not trained in dealing with similar electronic devices should not service this camera.
The camera contains components sensitive to electrostatic discharge. The handling of these devices should follow the requirements of electrostatic sensitive components.
Do not attempt to disassemble this camera.
Do not expose this camera to rain or moisture.
Do not face this camera towards the sun, extreme bright light or light reflecting objects, including laser sources.
When this camera is not in use, put the supplied lens cap on the lens mount.
Handle this camera with the maximum care.
Operate this camera only from the type of power source indicated on the camera.
Remove power from the camera during any modification work, such as changes of jumper and switch settings.

11.2. Typical Sensor Characteristics

The following effects may be observed on the video monitor screen. They do not indicate any fault of the camera, but do associate with typical sensor characteristics.

V. Aliasing
When the camera captures stripes, straight lines or similar sharp patterns, jagged image on the monitor may appear.

Blemishes
All cameras are shipped without visible image sensor blemishes.
Over time some pixel defects can occur. This does not have a practical effect on the operation of the camera. These will show up as white spots (blemishes).
Exposure to cosmic rays can cause blemishes to appear on the image sensor. Please take care to avoid exposure to cosmic rays during transportation and storage. It is recommended using sea shipment instead of air flight in order to limit the influence of cosmic rays to camera.
Pixel defects/blemishes also may emerge due to prolonged operation at elevated ambient temperature, due to high gain setting or during long time exposure. It is therefore recommended to operate the camera within its specifications.

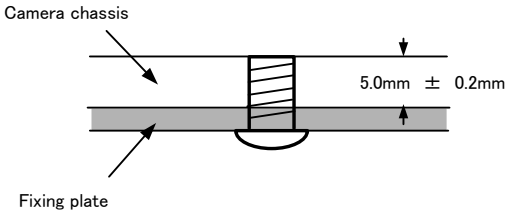
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear in the image.

11.3. Caution when mounting a lens on the camera

When mounting a lens on the camera dusts particles in the air may settle on the surface of the lens or the image sensor of the camera. It is therefore important to keep the protective caps on the lens and on the camera until the lens is mounted. Point the lens mount of the camera downward to prevent dust particles from landing on the optical surfaces of the camera. This work should be done in a dust free environment. Do not touch any of the optical surfaces of the camera or the lens.

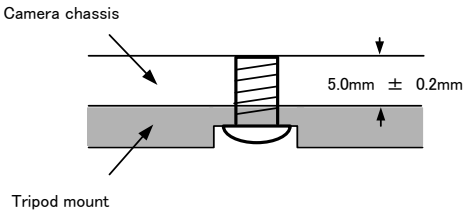
11.4. Caution when mounting the camera

When you mount the camera on your system, please make sure to use screws of the recommended length described in the following drawing. Longer screws may cause serious damage to the PCB inside the camera.



Mounting the camera to fixing plate

If you mount the tripod mounting plate, please use the provided screws.



Attaching the tripod mount

11.5. Exportation

When exporting this product, please follow the export regulation of your own country.

11.6. References

1. This manual can for BM-500CL / BB-500CL can be downloaded from www.jai.com
2. Datasheet for BM-500CL / BB-500CL can be downloaded from www.jai.com
3. Camera control software can be downloaded from www.jai.com

Index

Change History

Month/Year	Revision	Changes
June.2008	1.0	New release
Sept 2009	1.1	Add the limitation of the current for open corrector output.(5.3.3), Add the caution for screw used for installation(11.4).
July 2010	1.2	Change the Japanese text to English on Fig.10
Aug 2010	1.3	7.1 DIP switch, Correct the drawing (Position of open collector and Emitter follower was reversed
Nov.2010	1.4	Add the explanation of AGC reference to chapter 6.2.3.
May 2012	1.5	Delete Blemish compensation
July 2013	1.6	Protocol table revised, Gain spec. revised, Add the description for ALC, Tap Balance, Gain and ASC

User's Record

Camera type: **BM-500CL / BB-500CL**

Revision: **……..**

Serial No. **……..**

Firmware version. **……..**

For camera revision history, please contact your local JAI distributor.

User's Mode Settings.

User's Modifications.

Europe, Middle East & Africa	*Asia Pacific*	*Americas*
Phone +45 4457 8888 *Fax +45 4491 3252*	*Phone +81 45 440 0154* *Fax +81 45 440 0166*	*Phone (toll-free) +1 800 445 5444* *Phone +1 408 383 0300*

Visit our web site at www.jai.com

See the possibilities